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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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The Going Toughens

IN proclaiming on this page last week our faith in the products of the British aircraft industry, and in the present constitution of that industry, we were not merely banging the drum for the Farnborough circus. We do not believe that any of our visitors from overseas—not least among them Comrades Antonov and Yakovlev—would seriously contest the views that we then expressed. Rather their presence should do more than that: it should remind us of the stiffening competition now becoming manifest from every other country pretending to aircraft construction, the small as well as the great. Our salesmen have never had it so tough; and if this journal has rendered a particular service we believe it to be in the routine presentation not only of Britain's domestic products but, in equal detail wherever possible, the equivalent offerings of rival constructors. We are nevertheless uncomfortably aware that far too little is known, or heeded, about competing products. Only a few weeks ago we were discussing a forthcoming British aeroplane with someone who is to be largely concerned with its marketing. "It sounds as though it's going to be a direct competitor of the Blank," we remarked, naming a foreign aircraft of which particulars and pictures had appeared in this and other journals. "Don't know it," was the chilling answer. There is not a member of this journal's staff who has not had similar encounters.

We recall with the same discomfiture the smugness—even derision—with which our predictions of Russian infiltration into world markets have been met over the years. The smugness remains; but the derision seems to have vanished with the recent order for Il-18 turboprop airliners—by Ghana. Russian helicopters are already at work in many countries; and we must contend also with the mounting challenge of France, Germany and Japan.

Let us make Farnborough the occasion not merely for sales talk, but also for inquiry into our visitors' own products and commercial aspirations.

Corporation Co-operation

THE likelihood that KLM will associate with the SAS/Swissair consortium will mean that the airlines of five different nations—Denmark, Norway, Sweden, Switzerland and the Netherlands—will be setting aside nationalism and co-operating with the object of cutting costs. The same may be said of Air Union, which is to be the integrated airline of France, Germany, Italy and Belgium, despite all the difficulties of different tongues, currencies, traditions and temperaments.

A year ago a Parliamentary Select Committee asked BOAC and BEA to list the ways in which *they* co-operate. Their list (pages 351-354 of that report) revealed that there is in fact no technical or operational co-operation—and very little in a commercial way that does not exist in the normal way among airlines. The committee took rather a poor view of this and asked the corporations to look again at the possibilities of co-operation. This they have been doing, as noted in each corporation's annual report, and here is a step in the right direction. But we must hope that co-operation in fields other than medical services, motor transport, catering and so on will emerge. Even engineering consultation does not go far enough. By co-operation we mean what SAS, Swissair and KLM mean, and what the Air Union airlines mean. Is it not rather extravagant, for example, for BEA and BOAC, who have the same owner and who are based within three minutes' walk of each other, to have completely separate spares, maintenance, engineering and training organizations for their Comet fleets?

There is room for thought here; and room for action.

FROM ALL QUARTERS

The £150m Touch

EXPORT figures for July and the first seven months of this year show that the British aircraft industry's annual £150m rate of overseas sales is still being maintained, largely through increasing engine exports. The engine figure for July, £6.5m, was the third highest monthly total ever achieved; and the seven months' engine sales (£44.5m) exceeded all the annual engine totals since the war except for 1958 and last year.

The overall July total, £10,904,014, was made up as follows: aircraft and parts, £3,857,609; engines and parts, £6,451,792; electrical equipment, £279,885; instruments, £241,800; tyres, £72,928. Egypt was the leading buyer of aircraft, spending £1,162,145, and the US the best engine customer (£1,208,081).

Britain's First Satellite

THE British-instrumented artificial Earth satellite due to be launched from the United States by Scout rocket late next year will be a 20in diameter sphere weighing 100-150lb. Its orbit will be at an inclination above 50°, and will have a perigee of 200 miles and apogee of 600 miles. These details were given in a paper, *Instrumentation for the First Anglo-American Scout Satellite*, by Dr A. P. Willmore of University College, London, before a joint meeting of the British Interplanetary Society and the Society of Instrument Technology in London on September 1.

Details of the experiments to be carried out by this satellite were given in *Flight* of February 12, 1960. Electronics equipment for two of these experiments, Dr. Willmore disclosed, had been designed by Pye Ltd and Bristol Aircraft. In a discussion of international co-operation following the paper, the lecturer mentioned that University College scientific equipment was being flown in French Veronique sounding rockets from the Colomb-Bechar in the Sahara, and in Canadian sounding rockets from Fort Churchill.

Five other papers were presented at the symposium, which was devoted to rocket and satellite instrumentation.

AWA's New Managing Director

FOLLOWING the retirement (reported in our issue of August 19) of Mr H. M. Woodhams, chairman and managing director of Sir W. G. Armstrong Whitworth Aircraft Ltd, Sir Roy Dobson, CBE, HON FRAES, JP, has been appointed chairman and Mr W. S. D. Lockwood, OBE, FRAES, MIPRODE, managing director.

Mr W. S. D. Lockwood

Sir Roy is, of course, chairman and managing director of the Hawker Siddeley Group, of which AWA is a member-company. Mr Lockwood, who has been an AWA director for the past ten years and general manager for five, is recognized as one of the industry's leading authorities on production. After distinguished service in the Army in World War I he resumed technical studies at Bristol University, and in 1921 he joined the AWA design staff under Mr J. Lloyd, who retired last year. Mr Lockwood was closely associated with the design of many famous AWA aircraft in the inter-war years until, shortly before the outbreak of the 1939-45 war, he went over to the production side. He was made production manager in 1940 and works manager in 1944, and was appointed to the board as works director in 1950. In the past few years he has been responsible for all production work on the AW.650 Argosy and for directing and administering Seaslug production.

"Taffy" Jones

BY the death of Gp Capt Ira ("Taffy") Jones, aviation loses another of the dwindling band of colourful personalities who fought in both world wars. In the Kaiser's War he was credited with 40 air victories (28 aeroplanes, three kite balloons and ten "probables") and awarded the DFC and Bar, MC, DSO and MM; and he was also said to have come comparatively unscathed through 29 crashes.

Educated at Carmarthen Grammar School, Taffy went straight into the Welch Regiment at the outbreak of war in 1914. In the following year he transferred to the RFC. Many of his victories were gained in the later years of the war, when he was a pilot of No 74 Sqn under the illustrious "Mick" Mannock. His own story of this period was told in his book *Tiger Squadron*, published in 1954; he also wrote two other lively books, *Air Fighter's Scrapbook* and *King of Air Fighters*, the latter having his squadron commander as its subject.

He remained in the RAF after the war, retiring in 1936. At the outbreak of Hitler's War, by which time he was 43, Taffy Jones immediately rejoined the Service and was in due course placed in command of a Fighter OTU training Spitfire pilots. Impatient of the duties which kept him on the ground, he sought every possible excuse for flying. On one occasion, when a Ju88 was reported in the vicinity of the airfield, Taffy scrambled in an aircraft whose only armament was a Very pistol. Pursuing the enemy, he fired a succession of coloured lights—and the surprised German made off.

In later years Gp Capt Jones lived at New Quay in Cardiganshire. Two months ago he was injured in a fall; he was admitted to a Swansea hospital, where he died on August 29.

Leon Biancotto

PERHAPS it was not altogether fortuitous that Leon Biancotto—whose death whilst practising for the World Aerobatic Championships at Bratislava we briefly recorded last week—was interested in flying from a very early age: he was born near Le Bourget Airport in 1927, just eight days after Lindbergh landed there after his transatlantic flight. Biancotto learned to fly at the St Yan Centre in 1952 and, inspired by the feats of such famous pre-war pilots as Doret, Detroyat and Cavalli, many of whom he knew well, soon showed an aptitude for aerobatics. Within two years he was flying in aerobatic competitions and achieved second place in the Championatt de France.

He won the British Lockheed International Aerobatic Trophy when it was first held in 1955, repeated his success in the following year, and won for the third time in 1958. This year he was placed third. In 1957 he had been the winner of the Coupe Marcel Doret.

Biancotto, who for many years flew a Stampe biplane (though in this year's Lockheed contest his mount was a Nord 2302), held an unofficial record for inverted flying, with a time of 1hr 15min. He lived in Paris, and was married.

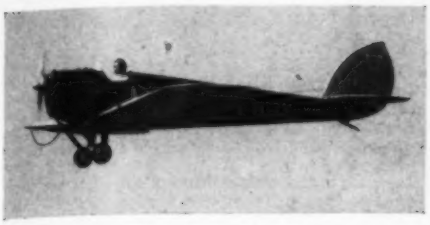
Fifty Years of D.H. Aeroplanes

TOMORROW, September 10, is the fiftieth anniversary of the youthful Geoffrey de Havilland's first flight. Now aged 78, Sir Geoffrey is today president of the de Havilland companies; and it was in the summer of 1910 that with F. T. Hearle he built and flew the first of five decades of successful D.H. aeroplanes.

Later this month there also falls the anniversary of the de Havilland Aircraft Company, which was founded at Stag Lane, Edgware, in 1920; and old times were pleasantly recalled at Hatfield on Thursday of last week (see "Straight and Level," page 424), when the D.H.53 Humming Bird of 1923 flew again. It is G-EBHX, one of the two 53s that took part—flown by "D.H." himself and his chief test pilot Hubert Broad—in the 1923 light aeroplane trials at Lympne.

The little Humming Bird (or *Oiseau-Mouche*, as G-EBHX is

***BLUE WATER:** This is the first photograph to be released of the British Aircraft Corporation's new surface-to-surface weapon. Designed and developed at the Stevenage weapon plant of English Electric Aviation, Blue Water is intended for mobile deployment and has inertial guidance and a solid-propellant motor. Dimensions are given as: length, 25ft; body diameter, 24in; span of movable wings (which closely resemble the control surfaces of Thunderbird) 6ft 9in; and span of fixed fins, 6ft 5in*



named) flies very well on its 40 h.p. ABC Scorpion, which is not quite as old as the aircraft, though it became the standard motor (the D.H.53 originally had a Douglas flat-twin motor cycle engine). When G-EBHX was discovered by the Shuttleworth Trust five years ago it was without engine, tail unit, controls, tanks or instruments; none of the drawings existed, and the missing parts were redesigned and built at the D.H. Technical School. ABC Motors and Alvis overhauled the engine, Fairey Aviation supplied a propeller and Dunlop made the wheels and tyres specially. Others who have assisted are BTH (magneto), Titanine (paint and dope), and Mr John Fricker (ABC engine parts).

Flight could not resist participating in last week's nostalgia: John Yoxall, who is now in charge of photography for Iliffe's 35 journals, was *Flight's* photographer in the old days, and he dug out his 50-year-old camera for the occasion. Like the D.H.53, and quite a number of the old-timers who were present, it still works.

***D.H. REUNION:** At Hatfield with the restored D.H.53 are: Sir Geoffrey, W. E. Nixon, F. T. Hearle, C. C. Walker, Sir Alan Cobham, A. E. Hagg, Hubert Broad. John Yoxall (back view, above right) took the group picture with the camera he used to photograph "D.H." and Broad (right) on another D.H.53 occasion 37 years ago (see foot of col 2 opposite). Top left: G-EBHX today*

W. S. Shackleton and Raymond Way

FURTHER information is now available about the agreement—briefly referred to in these pages last week—whereby Mr Raymond Way, the well-known Kilburn, London, used-car dealer, has acquired the share capital of W. S. Shackleton Ltd, the equally well-known aircraft sales and consultancy firm.

Under the new arrangements Mr W. S. (Bill) Shackleton retires from the board but assumes the office of president, and—states the company—"will continue to work with us for another ten years in that capacity and as technical consultant." Mr Way, as principal shareholder, takes over as chairman; Mr F. A. Dismore is appointed managing director; and Mr Keith Shackleton continues as sales director. Newly appointed to the board are Miss M. H. Campbell (Mr Way's personal secretary) and Mr T. J. Cable, senior partner in the firm of William Charles Crocker, solicitors.

It is stated that the company's policy will remain as before, and that no changes will be made in the staff—"but it is hoped that more rapid expansion of our activities can take place with the greater financial backing that will now be available."

IN BRIEF

Appointed assistant secretary of English Electric Aviation Ltd is Mr J. D. Maitland. Since 1958 he has been personal assistant to the managing director, Lord Caldecote.

Radio transmissions from Bell Telephone Laboratories, New Jersey, were received at the Royal Radar Establishment, Malvern, on August 29 after being reflected from the US Echo 1 satellite.

The New Zealand Government has set up an inquiry into the purchase of Canberra aircraft for the RNZAF in 1957. Its initial term of reference states: "When on August 14, 1957, the Cabinet authorized the purchase of 11 Canberra aircraft with spares and ancillary equipment, was that authority given upon the footing that purchase authorized was the purchase of aircraft with new as opposed to reconditioned engines?"

Six new cars (one costing up to £2,000) and 30 other prizes are offered to readers of *The Autocar* in a novel competition. Readers may enter by buying the enlarged special issues of September 9, 16 and 23, in which a series of spot-the-faults pictures will appear.

BLC FOR DRAG REDUCTION

ANNOUNCEMENT of the award of a contract to Northrop Corp (*Flight*, August 26), for the modification of two aircraft to incorporate suction boundary-layer control, marks a significant advance in the practical application of low-drag BLC. This will be the first time a modern high-performance aeroplane has had such a system incorporated over the complete wing surface. Previously, the only application of BLC has been in the form of blowing over leading and trailing edges and control surfaces, to improve low-speed control, take-off and landing characteristics. Production examples are to be found on the Vickers Scimitar, Blackburn NA.39, Lockheed F-104 and McDonnell F4H-1. In addition, Lockheed have extensively modified a single C-130B to obtain the same objective (*Flight*, June 24, page 866).

However, Northrop have been developing a practical form of BLC using suction not as a high-lift device but to obtain a marked reduction in aircraft drag. This has the prime objective of greatly increasing the obtainable range of a given long-range aeroplane design. The US Air Force's interest in this type of aeroplane was stressed at San Diego during last month's conference covering future requirements for manned aircraft. The trend in world tensions is increasing the need for such long-range transport aircraft, since many overseas bases are having to be vacated owing to adverse local feeling.

Northrop's theoretical and experimental research in the field of drag reduction by the use of BLC started in 1949. This work has been done by a team led by Dr Werner Pfenninger, who has explored such fields since 1940, originally in his native Switzerland. Because of the fundamental difference between their system and mere flap-blowing, Northrop call it LD-BLC (Low Drag—Boundary Layer Control). It uses suction through a system of spanwise slots, spaced to obtain complete laminar flow over the entire wing.

Initial testing in the NACA TDT tunnel in 1952 showed that complete laminar flow could be obtained to a Reynolds number of 16,000,000. Continued research led to the development of a practical suction system obtaining laminar flow while maintaining structural rigidity. It was tested on a modified F-94A aircraft, which was flown initially with the original tunnel scheme and then modified to a suction configuration more compatible with airframe and manufacturing requirements. These tests, run in over 300 flights over a period of two years, proved highly successful, and 100 per cent laminar flow was achieved at Reynolds numbers as high as 36m. Concurrent analytical research led to methods suitable for the determination of suction requirements, distribution and power, and effective drag.

Other tunnel research showed that it was possible to obtain laminar flow over a 30° swept wing at an R of 12m, and later at an R of 28m. Moreover, laminar flow was maintained on a biconvex wing at speeds of up to M2.7. During the flight-test and tunnel programme, it was found possible to determine the effects of surface finish, waviness, damage, rain and flies on the efficiency of the system. Rain reduces the efficiency of the system considerably, but only during direct exposure; on a flight from Edwards AFB to Dayton, Ohio, it was found that laminar flow ceased while flying through a rainstorm, but was regained upon coming out into clear air.

As a result of this extensive programme, conducted under the auspices of Wright Air Development Division, Northrop suggested to the Air Force that the time was ripe for the accurate assessment of the characteristics of a laminarized aeroplane, with regard to overall efficiency, fuel consumption and performance. The suction system would be independent of the propulsion system, to achieve the desired experimental flexibility. This suggestion resulted in the awarded contract, which has as its objectives the evaluation of the true value and cost of laminar flow-control at the earliest possible date. The data will be obtained in a form directly applicable to the design of future aircraft. In particular, the effects of weather and adverse operating conditions will be fully investigated.

Northrop's contract, awarded by the USAF Air Research and Development Command, is scheduled to cost about $27m spread over the next three years. Although the company's announcement

BLC FOR DRAG REDUCTION . . .

did not disclose the type of aircraft involved, it is believed they will be Douglas WB-66Ds. Their wings and tail surfaces will be largely rebuilt to accommodate plenum chambers, ducting and new skins with suction slits (the precise and economic cutting of which will be the subject of a major part of the investigation). The slits will have widths up to 0.0625in, and will be spaced closer together as distance across the chord increases.

Examination of the B-66 airframe shows that on a number of counts it would be particularly suited for modification in this particular application. The high mounting of the one-piece wing makes it a comparatively simple matter to replace it by a new one incorporating the necessary suction system, and the landing gear would not require redesign as it is housed entirely within the fuselage. Ample volume is available in the fuselage for the suction power source and instrumentation. As one of the objectives is to achieve a much greater range, it would also seem logical to fit a more up-to-date engine under the modified wing. Putting two and two together, it is our hunch that Northrop would consider it desirable to fit two of the new turbofan engines, as exemplified by the CJ805-23 or the P & W JT3D (both have military sponsorship, as the TF35 and TF33 respectively). Northrop state that their Boundary Layer Research Group have conducted studies to determine engine inlet and exhaust noise-suppression techniques and levels, in addition to exploring the effects of high-energy sound waves on laminar flow conditions.

One may look more closely at the incorporation of LD-BLC into the wing structure. Northrop make great play of the manner in which the system uses slots, rather than holes, to suck the boundary layer through, and stress the methods developed to machine these to the required close tolerances. These include special slitting heads and tooling, prepared by numerical control, for the manufacture of bonded components. The original B-66 wing forms integral tanks between the two spars. As modified, one method of retaining internal fuel would be to use a double-skinned torque box in which the inner skin is "solid" and the outer envelope contains the spanwise slots. The problem is eased somewhat by the lower dynamic air pressure, which reduces the suction duct area required. Leading and trailing edges could use a hollow construction similar to that employed in some hot-air de-icing systems.

Northrop say the air is "siphoned through the slots and into ducts in the airframe, then exhausts backward to provide extra thrust." Lockheed found it necessary to add two specially podded shaft-turbine/compressor engines to provide the "blowing" power on the NC-130B. It is difficult to compare the requirements of "blowing" and "sucking" systems, but Northrop's "sucker" will probably be installed within the rear fuselage.

LD-BLC would fit well on the Caravelle, Trident, Vickers VC10 and Super VC10 configurations, with their uncluttered wings and aft-mounted engines. Northrop's claimed increase of range would make the Super VC10 capable of carrying 58,000lb over a stage length of 7,000 miles instead of the present 4,000 miles. This would permit flights to anywhere in the Commonwealth, with only one stop for refuelling.

It is for such a mission that Handley Page Ltd have for so long been working. We reported the all-wing, all-laminar H.P.117 in our September 2 issue; in our July 5, 1957 issue some of their projects for low-drag laminarized aircraft were studied, and we had previously several times published reports of their studies and of work with special gloves fitted to the wings of a two-seat Vampire. As far back as 1937 Miles Aircraft built a specially modified Peregrine with suction over the upper surfaces of the torque box. But the contract with Northrop is the first to show any real attempt by a nation to try to reap a reward from this most promising idea.

INSIDE SPADEADAM

SPADEADAM is a name which for many of us has conjured up a picture of bleak Cumberland moors and a single desolate rocket test stand. Last week the Ministry of Aviation opened the Spadeadam Rocket Establishment to the Press for the first time, and the reality was rather different. Certainly the surroundings are desolate, but the establishment itself is very much otherwise. It was at once possible to see why this big complex has consumed more than £20m (as was recently revealed in the second report of the Committee of Public Accounts).

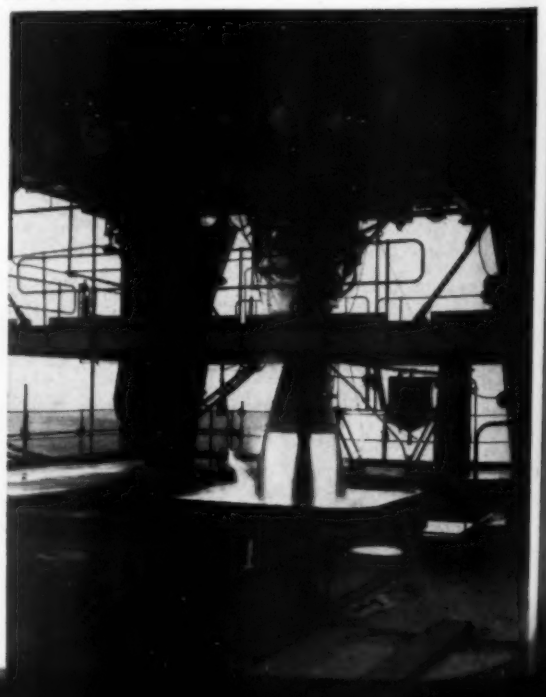
Unlike other Government research establishments, Spadeadam was built for one task only: the complete static testing of the Blue Streak ballistic missile and, in particular, its rocket engine. The latter is a product of Rolls-Royce Ltd, who on behalf of the MoA manage the establishment.

More than 2,000 were engaged in building Spadeadam; the principal contractors under the Ministry of Works were the *ad hoc* firm British Oxygen Wimpey Ltd, and the chief sub-contracts were placed with British Oxygen Engineering (for a liquid-oxygen production plant and general cryogenic installations) and Pye Ltd (instrumentation). Total staff today number about 600, representing Rolls-Royce, de Havilland Propellers and British Oxygen Gases. Since Blue Streak was cancelled as a military weapon earlier this year their work has continued on a reduced scale, pending the Government's decision on a British space programme. But the huge task of completing installations and instrumentation is steadily forging ahead, and the engineers with whom we talked last week were anything but despondent about future prospects.

The engine itself, designated Rolls-Royce RZ.2, was described to us as "a very reliable workhorse"; it has since been overtaken by later American designs but, like most things that bear the R-R hallmark, has demonstrated excellent characteristics and reached a most satisfactory state of development. In the engine fitting shop at Spadeadam we saw five RZ.2s on vertical stands and four more on horizontal transporters. With their silver thrust chambers, yellow Alochrom finish of the turbopumps, scarlet transportation pipe-covers and green erection stands, they made a colourful spectacle. Engines are handed into an A-pack and B-pack, linked in each missile to form the complete twin-engine powerplant.

Spadeadam itself covers some 10,000 acres, over most of which sheep still graze. Widely separated are five major areas: administrative, missile test, engine test, component test, and liquid-oxygen factory. There are five stands capable of running complete engines (a sixth, of novel design, is near completion) and three of these can each accept an entire Blue Streak. A more detailed description of the establishment will be published in next week's issue.

The Rolls-Royce RZ.2 engine is derived from an earlier unit rated at 135,000lb at sea level, and two are used in the Blue Streak missile. Right, a single RZ.2 is firing on stand A3, while below is part of the component test area (note flame from turbopump gas generator)



This is the first impression to be published of Avro's short-range jet, the 771, referred to elsewhere in this issue. Engines selected are two BS.75 turbofans; maximum weight is 52,000lb; and a maximum of 60 economy-class passengers will be carried at up to 570 m.p.h.

AIR COMMERCE

SKYWAYS AND THE ARGOSY

NEGOTIATIONS are taking place between British European Airways and Skyways with a view, *Flight* understands, to the independent airline operating three Argosies for BEA on European all-cargo services. Under BEA's original tentative arrangement with Hawker Siddeley (*Flight*, April 8), three Argosies were to have been operated under a lease arrangement. It is clear from BEA's 1959-60 report that the corporation, mindful of the very large amount of cargo capacity that will be available in its Vanguard and D.H.121 fleets, has been having second thoughts about equipping itself with a specialized new all-cargo aircraft.

"It has become apparent," says BEA, "that the factor which will dominate BEA's freight policy in the next five years is the vastly increased dead-load capacity which will be available on passenger services . . . Our freight policy must therefore be aimed primarily at maximizing the sale of this by-product." Explaining that a requirement for an all-cargo aircraft nevertheless still arises, BEA's report goes on: "We are giving serious consideration to the Armstrong Whitworth Argosy. The capacity of this aircraft may, however, prove to be too large for BEA requirements and it may be more economical for the corporation to convert a number of V.800 Viscounts to a cargo configuration." The statement explains that no decision has yet been reached about future freight aircraft, but that "we have thought it desirable to report fully, at this stage, on the factors which will shape BEA's freight policy in the next few years and thus give the logical background to the decision which is eventually made."

If the proposed arrangement with Skyways materializes it will mean that this airline will be the most up-to-date of all British independents, being an operator of both the Avro 748 and the AW.650 Argosy. It seems logical that Skyways would be entrusted with the job, their freight partnership with BOAC having worked well. Trans Arabia Airways, whose provisional order for two aircraft is now understood to have lapsed for the time being, has meanwhile ordered three converted DC-6Bs.

According to a US source, Riddle's order for five Argosies, for use on MATS "Logair" work, is firm and delivery of all five aircraft has been promised by February next. Price paid by Riddle exclusive of spares is $1.31 million (about £468,000) per aircraft.

BEA AND THE HERALD

A SURPRISING omission from BEA's 1959-60 annual report was any mention of the corporation's plans to operate the Herald on its Highlands and Islands services—or, indeed, of any reference to the Herald at all, although it has been flying for a year or more in the corporation's colours.

It will be recalled that, as long ago as June 1959, the then Minister of Supply, Mr Aubrey Jones, said that three Heralds were to be ordered by the Ministry from Handley Page, for a price of £750,000, for operation by BEA. A corporation spokesman said last week that, so far as BEA is concerned, the Herald arrangement still stands; but he could give no indication as to when operations were likely to begin.

It is not clear what is holding up the BEA Herald programme, the speedy implementation of which is obviously in Handley Page's interests. But it is reasonable to speculate that the contract between the Ministry of Aviation and Handley Page could not reasonably be finalized by the Minister during the course of discussions about HP's association with one or other of the major airframe groups.

The fact that one of these groups, Hawker Siddeley, is producing the competitive—though less far advanced—Avro 748 is obviously a matter that has to be taken into consideration.

QANTAS PROFIT PUZZLE

LAST spring *Flight* came under fire from Australia for suggesting (December 11, 1959) that Qantas makes a profit largely as a result of extraordinarily high mail rates. Our friends on *Aircraft* said that we were "up a gum tree." Although disputed, the validity of our suggestion is undeniable, and it is confirmed by the latest Qantas report. This shows that operating profit doubled in 1959 to exceed £A1 million, or £A850,000 net.

It remains true to say that generous mail rates are the backbone of the Qantas economy. But to pinpoint the reason for last year's remarkable improvement is entirely another matter—a matter upon which, alas, the report gives no guidance. The chairman's single-sentence explanation is to the effect that the improved profitability was thanks to the competitive advantages of Qantas's early introduction (July 29, 1959) of the Boeing 707. The fact is that the key to the airline's profitability in 1959 lies in a rise in traffic revenue of 19 per cent (to £A26 million) over a period when traffic rose by only 12 per cent (*total* revenues rose even more sharply, by 23 per cent, to reach £A29¼ million).

The normal reason why revenues rise more sharply than traffic is that average revenue rates have increased. Yet here lies the mystery of Qantas's increased profit: every item of evidence in the report suggests that revenue rates have in fact fallen. The only explanatory clue is a statement that the yield per mail ton-mile was less in 1959 than in 1958. When this is taken against a *fall* in mail ton-miles of 4 per cent and a *rise* in mail revenue of 8 per cent it is obvious that the airline is being paid for mail which it does not carry. In other words, perhaps, that the pool agreement with BOAC is working out to the advantage of Qantas. It is fair to deduce, in the absence of any information about pool agreements, that the same situation obtained in respect of passenger and freight traffic.

Although costs rose by 20 per cent to £A28¼ million, capacity increased at a slower rate (14 per cent) to 148 million c.t.m. Thus cost level might have been expected to rise. However, the report's clear statement that cost level has fallen very slightly (to 39.6d per ton-mile) can only mean either that Qantas is incurring a large volume of expenditure on activities other than aircraft operation, or that the airline's definition of cost level differs from that which is commonly accepted.

In the current financial year the Qantas fleet of seven Boeing 707s will be in full service, and this should mean a further rise in profits—unless, of course, the terms of the BOAC/Qantas/Air-India pool prove to be particularly disadvantageous to the Australian airline. Two factors will tend to offset the Boeing's profitability. In the first place, the airline will have to adopt a more rigorous obsolescence policy with the jets than it has apparently in the past with its piston aircraft. And secondly, the astronomical recent rise in Qantas' capital (nearly doubled over the past two years) will result in much heavier financial charges. Indeed, net assets valued at £A41 million stand so high in relation to revenue that an accountant might be forgiven for thinking that the Qantas balance sheet, like so many others, depicted the business of a "heavy industry" rather than an airline.

WALK UP, WALK ON

THE effect upon Allegheny Airlines of the no-reservation ("walk-on") ticketing system introduced in October 1959 has been remarkable. Allegheny's main competitor on the route concerned (Philadelphia - Pittsburgh) is TWA, who operate Super Constellations in competition with Allegheny's Convair 440s and turboprop (Napier Eland) Convair 540s. Allegheny's 540 has a slight edge (10min) on speed, but this cannot entirely account for the big rise in their business.

Last October, when the experimental commuter scheme was introduced with the approval of the CAB, TWA's share of the market was 122,000 passengers compared with 3,000 for Allegheny. Eight months later the shares were 114,000 and 44,000. Allegheny now reckon that next year their traffic will be 91,000 compared with TWA's 150,000 passengers.

The new system was described in a *Flight* report from Philadelphia in the issue of May 27, 1960, pages 738-739. The airline has applied to the CAB to use the system on other routes, and it can be assumed that in this country BEA are watching events closely with a view to introducing a similar scheme on UK trunk routes, possibly in the spring of 1962.

VTOL control from fans driven by bleed air, or variable-thrust banks of lift engines? The photograph shows the latter, one of the studies into the control of VTOL transports being conducted by Boulton Paul. The engine pods can clearly be faired off for cruising flight

AIR COMMERCE . . .

SABENA SUBSIDIZED

THE latest annual report from Sabena is a none-too-cheerful document. In a year which was generally a period of rapid recovery, the Belgian national carrier suffered a five per cent loss of traffic and finished up with a loss of Fr. 198 million (£1.4 million), which was met by a State subsidy. On total revenues equivalent to £24 million, this is not a good result.

The report puts the blame for the loss on the delayed improvements in the Belgian national economy and on the long-term stagnation experienced in the economy of the Congo. However, the stark figures have a different story to tell, for at over 40 pence per c.t.m. Sabena's costs appear to be unduly high. At about 14,000 c.t.m. per employee their annual staff productivity is abnormally low (even by comparison with other European operators who average about 20,000 c.t.m. annually). And at £33 million, the capital tied up in the airline is out of all proportion to the current level of business.

The general pattern of Sabena's traffic in 1959 remained largely unchanged: of total traffic, routes between Belgium and the Congo accounted for one-third; those across the North Atlantic for one-quarter; those in Europe for one-fifth; the remaining tenth represented the Congo internal traffic. These proportions underline the extent to which Sabena will be damaged as a consequence of the current crisis in the Congo. The loss of Congo traffic, the company's apparently extravagant use of men and money, and the probability of severe capital losses on the fleet of nine DC-7Cs, all point in one direction: the Belgian taxpayer must be prepared to come to Sabena's aid for quite a few more years yet.

FIXED-PERIOD NOTAMS

ONE of the difficulties with the present Notam system is that applications of procedural changes come into force at random intervals. It has been argued that it would be much more desirable if the flow of information could be regulated so that charts and route manuals could remain up-to-date for at least a minimum fixed period. Fixed-date implementation would also assist those whose task it is to amend the manuals and pilots who have to operate the new procedures—in this way there should be fewer loose pieces of paper and less handwritten amendments. (A recommendation for such a scheme was made in *Flight*, March 25, page 415.)

MoA *Civil Aviation Information Circular* 90/1960 introduces such a system. The essence of the plan is that any permanent or semi-permanent alterations to FIRs, controlled airspaces, radio aids, communication facilities, aerodromes, meteorological facilities and the like shall be made at fixed twenty-eight-day periods. In addition, twenty-eight days' notice shall be given. A new instrument landing procedure, for example, would be announced in the Notam due to be published on September 29, 1960; would come into effect on October 27, and should not then normally be altered until the start of the next twenty-eight-day period, i.e. November 24. However, cases of operational urgency will be allowed to override the plan.

Those responsible for production of charts and route manuals may look forward to receiving amending information on set dates, in the expectation that it will remain current for a further four weeks at the minimum. If the scheme succeeds it will be most advantageous; but at the same time the Aeronautical Information Service, as originators of the information, will constantly have to think nine weeks ahead (one week for printing, four weeks' prior notice and four weeks' validity of information). Optimism will clearly have to be tempered with allowances for human frailty.

CRISIS IN CEYLON

THE chairman and the general manager of Air Ceylon, Mr P. Nadesan and Mr J. L. M. Fernando, have resigned following charges of maladministration made by the Air Ceylon Pilots Association.

Among the allegations made are: improper administration and control of the agreement with KLM, with the result that Ceylonization has been restricted; favouritism and nepotism in the matter of appointments and promotions; and abuse of privileges and facilities by the management for their own personal benefit. The pilots appear to be particularly piqued that there are no Ceylonese pilots on regular international flights, although "some of the pilots who have left Air Ceylon for other countries are doing extremely well."

Air Ceylon's crisis lies deeper than a dispute with dissatisfied pilots, although it is the latter's Association that has voiced the nationalistic aspirations of the airline. Air Ceylon's chairman had said that the purchase of competitive types of aircraft for both international and regional services would cost over Rs 25 million. The pilots reply that this is absurd and that the ex-chairman is apparently ignorant of the reasons why Air Ceylon has been restricted in obtaining traffic rights in neighbouring countries—it has been disqualified because the crews operating international services are Dutch and not Ceylonese.

At the behest of the Ceylon Minister for Transport, Mr Nadesan said in answer to the pilots' charges that allegations of maladministration in Air Ceylon had been made so frequently that "it would be in the best interests of everybody that they be investigated and the truth ascertained." The international service had been run at a loss from its inception, but none of the losses had been borne by the airline. Commissions received from KLM had helped to offset heavy losses on regional services. Seven out of ten passengers on Air Ceylon's internal flights, he said, were government servants who do not pay for their tickets. Mr. Nadesan added, "I have no charge to answer as regards my period of stewardship. I have worked without remuneration—being the only chairman of a State corporation to do so. I have formulated a budget and a cadre where none existed before, and settled every conceivable dispute that existed between the management and personnel by meeting the trade unions myself."

VISCOUNTS FOR CAMBRIAN

CAMBRIAN AIRWAYS hope to introduce Viscounts in 1963. This was said by Wg Cdr L. B. Elwin, the airline's managing director, in announcing that Cambrian will re-open a winter service between Cardiff, Bristol, Southampton and Paris on October 31. There will be three return flights a week.

Wg Cdr Elwin said that the airline's international traffic had this year expanded by 52 per cent, of which 39 per cent was on the Paris service alone. Traffic to the Channel Islands had also increased and would have been higher than the 14 per cent achieved had it not been for construction of the new runway at Guernsey. Increase in traffic by centres on the Paris route was: Southampton, +25 per cent; Bristol, +43 per cent; and Cardiff, +50 per cent. On the Channel Islands services, passenger traffic at Cardiff and Swansea increased by 20 per cent. Domestic services were "carrying traffic in excess of the level budgeted for."

Making reference to the new service which Cambrian hope to operate between London, Bristol, South Wales and Cork, Wg Cdr Elwin said that: "We can only expand . . . if the travelling public support us. I am pleased to say they are now coming forward in ever-increasing numbers, but there is still ample capacity over all routes available for sale."

Of Cambrian's future policy the managing director said: "Our policy is to develop inter-city and Continental services serving Bristol, Wales and the west of England, wherever possible with our own services . . . or by being complementary to larger national operators."

CANADAIR 540s FOR QUEBECAIR

THE Canadian local service airline Quebecair has ordered from Canadair two Napier Eland powered Canadair 540s to supplement its fleet of three Fairchild F-27s, three DC-3s and two Cansos. The first is already in service, making a daily return trip over the 800-mile route Montreal - Quebec - Rimouski - Seven Islands - Wabush Lake - Shefferville.

AIR COMMERCE . . .

In use in West Africa as a feederliner for more than seven years, Herons are now operated on local services out of Accra by Ghana Airways

AMERICAN SUPERSONICS

WILL the US Government finance the production of America's supersonic airliner? The answer is certain to be yes; and here is the view of the FAA as expressed by Mr James Pyle, the deputy head of the Agency, to the US National Academy of Sciences last month:——

"In the past, major shifts to larger and faster aircraft have characteristically involved lower, or at least potentially lower, seat-mile costs—a fact which helped considerably in meeting the many economic problems that accompany modernization of an air fleet. It may be difficult to achieve seat-mile costs for the supersonic transport that are any lower than those of today's jets. However, comparable costs, at least, appear possible, and attractiveness of the higher speeds to users is expected to result in the domination of all routes of 2,000 miles or more by the supersonic transports. This nation's airlines would therefore have to acquire supersonic transports to remain in the international market, despite possibly higher operating costs, payment still due on subsonic jets, or even possibly the fact that the supersonic transports were not of United States manufacture.

"The competition in supersonic transport development will be keen. Both Great Britain and France have signified a definite interest in the development of such aircraft, and government support for these programs may be taken for granted. The Soviet Union also is expected to work aggressively toward placing a supersonic transport in service as soon as possible.

"The competitive success of the United States in world commercial aviation and the respect for United States transports as technical achievements have been very important both in prestige and in the maintenance of export levels. However, our leadership in aviation is being challenged aggressively on both sides of the Iron Curtain. These facts, together with the general responsibility of government for progress in transportation, stimulate our interest in the problem regarding the supersonic transport."

NEXT STEP TO A MIDLAND AIRPORT

PLANNING permission for the development of the north Leicestershire airfield of Castle Donington has now been applied for by Derby Corporation. It is understood also that a firm offer for its purchase has been made to the Air Ministry, who own it. Derby Town Council have earmarked £75,000 in the financial estimates for airport development in 1960/61 and £110,000 has been carried forward for work later.

Re-opening of Castle Donington as an airport for Nottingham, Derby and Leicester was proposed some while ago, and in March (see *Flight*, March 25, 1960) the five town and county councils concerned jointly contributed £2,500 towards the cost of a comprehensive survey. Plans for a Midland civic airport have the full support of Derby Aviation, whose development is to some extent restricted by lack of runways and hardstandings on Derby's grass field. They foresee that their move might be made in about two years' time when it could coincide with long-term plans to introduce a turboprop—possibly as a member of the independent six-pool, the formation of which is still under active consideration.

Because of their geographical location Derby Aviation have always had to be unusually self-sufficient and self-contained and if they did move to Castle Donington it would be a lock, stock and barrel operation. Rather than build a new £150,000 hangar, the present building could probably be cheaply re-erected.

The airline still leans towards the Herald as its future turboprop; Derby particularly like it as the fuselage is large enough to accommodate the spare engines which they freight for Rolls-Royce and because wing repairs and changes should be relatively simple. At one time Derby proposed to operate the first production Herald on a charter basis. This aircraft was the one that was destroyed and its successor has subsequently been very busy with demonstration tours. But provided Handley Page are willing to charter out an aircraft at a price that would give Derby a reasonable profit margin the airline would "still be very interested."

BRITAIN'S TRANSATLANTIC TERMINALS

HOW is traffic shared between the three British airports which cater for transatlantic jet traffic? The answers are shown below, but they require careful interpretation before a true picture of progress at individual terminals can be presented.

There was a big fall in Manchester transatlantic traffic from the US in 1959-60, as is shown in the table below, but it is accounted for by the fact that in the previous year some 11,000 MATS passengers were handled there.

The following table shows how the three main UK transatlantic terminals have fared over the last two years:—

	London		Prestwick*		Manchester		Total
	1958-59	1959-60	1958-59	1959-60	1958-59	1959-60	
Pass to/from UK-Canada	75,817	81,282	24,715	29,249	5,212	6,462	
Percent total UK	72	69	23	25	5	6	
Percent rate of growth ...	+7		+18		+24		+11
Pass to/from US-UK ...	281,286	377,666	45,139	47,683	21,862	15,839	
Percent total UK	81	85	13	11	6	4	
Percent rate of growth ...	+34		+6		−28		+27
Pass across N. Atlantic ...	357,103	458,948	69,854	76,932	27,074	22,301	
Percent total UK	79	82	15	14	6	4	
Percent rate of growth ...	+29		+10		−18		+23

*Main runway closed for first 2½ months of year 1958-59.

The Tri-Pacer in this PanAm DC-7F is one of a number that have been air-freighted to LAP from Boston in about 15hr. This gives the recipients, Grantair of Grantchester, just sufficient time to prepare for the light aircraft to be Customs-cleared on the tarmac and loaded on to a specially modified car transporter. An imported aircraft can be airborne with a hire-and-reward C of A seven days after leaving the US

Blackburn Engines have recently delivered starter trucks to the MoA at Prestwick Airport. The Bedford carries a Palouste silenced l.p. air starter in the form of a pack, which can be truck or trailer mounted or used in its own right on the ground

AIR COMMERCE . . .

THREE THOUSAND HOURS FOR THE DART

THE highest overhaul period achieved by any commercial aircraft powerplant has been granted to Rolls-Royce Darts in service with TCA. The airline have been operating Dart engines in Viscounts since 1955, when the overhaul life was 600hr. During the past few months the overhaul period has been uprated at increments of 100hr every two weeks.

There are some 235 Dart 506s in TCA service or as spares and these are overhauled at Winnipeg. The new 3,000hr overhaul life means that, at the current rate of utilization of TCA's 49 Viscounts, engines will become due for overhaul approximately once every calendar year.

NEW ANGLES ON TRAFFIC RIGHTS

REPORTS that the Americans are attempting to restrict seats offered by SAS in the USA, and that they are also asking SAS to provide statistical information about traffic to and from the US, are significant for two reasons.

Firstly, the Americans hitherto have always shunned the limitation of capacity—predetermination as it is generally known. It is believed that they were rather unwillingly forced into a restrictive agreement with India, the relevant bilateral limiting US rights in India, but this would be the first time that the Americans had ever tried to impose capacity restrictions on a foreign operator.

Secondly, the request for traffic data is a new kind of traffic rights bargaining-counter. The Americans recently got the Italians to agree to such a request.

SAS have also been having traffic difficulties with the West Germans, who are reportedly trying to limit SAS's fifth freedom "beyond" rights between Germany and the Far East. Matters even reached the point where the Germans were said to have mentioned to the King and Queen of Thailand, during their State visit, the question of Lufthansa's traffic rights in Thailand. The Thais—whose airline is associated with SAS—had refused Lufthansa's previous request.

But this is not the first time that royalty has been brought into a scuffle over traffic rights: Prince Bernhard of the Netherlands, it will be recalled, had quite a lot to say about the Americans on this subject a few months ago (*Flight*, February 5, page 188).

FRANCE GIVES LONDON TO THE US

AMERICAN carriers flying between New York and Paris, namely Pan American and TWA, can now make a traffic stop at London. This has been agreed between the Americans and the French, and their bilateral air agreement has been amended accordingly.

It will not, of course, be possible for Pan American or TWA to exercise their rights at London on a New York - Paris route unless —and this seems extremely unlikely—permission can be obtained from this country. The prospect of an American carrier on the London - Paris route would obviously not appeal to BEA, though there is no apparent objection from Air France.

In exchange for the addition of London as an intermediate New York - Paris point, the French airline gets a traffic stop at Montreal on the route between Paris and Los Angeles. The Americans also obtained French permission for all-cargo flights stopping at London to serve other points in France; it is probable that the British attitude, which is in general more liberal to US all-cargo operations, may regard this development more favourably.

In the meantime there is no news of any *rapprochement* between the British or the Americans in respect of the deadlock reached last May, following an earlier deadlock in March at Barbados in negotiations to amend the Bermuda agreement.

WHICH ARE THE BUSIEST AIRPORTS?

HALF a dozen British airports showed astonishing increases in passengers handled during the first half of this year. Leading once again was Leeds/Bradford, with an increase of 108 per cent on last year's figures. Some of the reasons for these changes were set out in *Flight*, August 5, page 198. Close behind Yeadon were Southend (94 per cent), Newcastle (89 per cent), Birmingham (71 per cent), and Cardiff (64 per cent). Perhaps surprisingly, traffic at Turnhouse increased more than it did at Renfrew, and at Stansted and Eastleigh—both under threat of extinction—more than at Ringway and Speke.

BREVITIES

It is reported that Cathay Pacific are considering buying Comet 4Cs to meet jet competition in the Far East.

Mr A. C. Ping has been re-appointed by the Minister of Aviation, Mr Peter Thorneycroft, as a member of BEA's board for a period of a further two years.

Mexicana inaugurated non-stop Comet 4C services between Mexico City and Chicago last month at a frequency of five and ten flights per week.

The CAB is investigating the practice of booking more seats than there are available on US domestic flights. The inquiry is not disciplinary in nature but merely fact-finding.

"Airport improvements for safety in the jet age" is the theme of the US Air Line Pilots Association air safety forum, to be held in Chicago between September 13-15.

ICAO has recently issued five parts of a new manual on aerodromes. It covers data on aircraft characteristics, pavement strength, obstruction surveys, rescue and fire fighting equipment, visual ground aids, and so on.

It is possible that Avro will demonstrate the 748 in Vienna in the near future. Interest has been expressed both by the Austrian Air Force and by Aero Transport and Austria Flugdienst, the two independents who are proposing to merge.

The general manager of the former West African Airways Corporation, Mr D. Malcolm Brown, has been appointed by George Weston Holdings Ltd managing director of the travel and freight agents, A. H. Fuller Ltd.

The Grampian Property Co, whose general manager is Mr George Bell, is planning an air terminal for Glasgow, in the Gorbals area overlooking the River Clyde. It will incorporate a 200-bedroom hotel and cost several million pounds; the site might also include a heliport. A decision on construction of the terminal will be made towards the end of the year or at the beginning of 1961.

South African Airways will operate four services a week to Europe instead of five as at present when their Boeing 707s go into service in October. Nevertheless, an additional 180 seats per week will be on offer. London services shown on the proposed timetable are routed via Salisbury, Nairobi, Athens and Rome; Brazzaville, Rome and Amsterdam; and Salisbury, Nairobi, Rome and Frankfurt.

Pratt & Whitney (JT3) engines have completed a million hours in airline service.

Philippine Airlines' annual report for 1959 has won an award from the magazine *Financial World*. The report is said to be the most progressive in providing the fullest financial information to airline shareholders.

The FAA are studying operational and control procedures for parallel runways at major airports, including the question of how close together such runways can be spaced.

Price of the Convair 60 short-medium range jet project will be $3.5 million (£1.25 million), according to reports from an American source.

It is reported that Aeronaves de Mexico, who operate two Britannia 305s, are likely to obtain from the US "beyond rights" on their Mexico-New York service to Europe.

It is reported that Alitalia will increase its order for Caravelles from eight to 12 aircraft. The Italian airline's order was increased from four to eight earlier this summer. As with KLM, Alitalia's choice of medium jet equipment is reportedly likely to be the Convair 600.

The first of NAC's Friendships should reach Wellington on November 21 and enter service on the Christchurch - Wellington - Auckland route on November 22. The second aircraft will arrive in January, the next two aircraft in February and March.

Ansett-ANA have deposited £5,000 with Sikorsky in order to secure an early place on the production line of the S-61. This is not a letter of intent; interest in the S-61 is equivalent to the airline's interest in the Super Broussard. "We may buy," Mr R. M. Ansett said recently, "if development meets our specifications and other circumstances are right."

Qantas will charter a Super Constellation from Lockheed to replace the aircraft which crashed on take-off from Mauritius on August 25 after failure of an engine. Six of the 38 passengers were injured. Another Australian operator, Ansett-ANA, is to take over a Viscount 812 from Continental Airlines, and TAA has applied to the Commonwealth Department of Civil Aviation for permission to buy a Viscount from the same source. The TAA aircraft would replace the Friendship which was lost near Mackay.

TWENTY-FIRST SBAC SHOW

The Regrouped Industry Displays its Wares

TWENTY-FIRST anniversaries ought to be bright, cheerful, colourful affairs; and although there was no gilded key last Monday to open the Society of British Aircraft Constructors' Flying Display and Exhibition there was no lack of colour, brightness and sociable (and presumably also commercial) cheerfulness. Chiefly this environmental gaiety was due to the weather; for with Monday a warm and sunny ridge-of-high-pressure day, the SBAC seemed initially to have fallen on its feet again, meteorologically speaking, in its perennial choice of early September: so that even a static display of aircraft that contained nothing wholly new except the Avro 748 looked rather more handsome and prepossessing than it might have done under the grey skies and constant rain we have become accustomed to in 1960's summer. The 748, G-APZV, made its maiden Farnborough appearance becomingly: the aircraft's dark-blue-and-light-blue cheat line, with white fuselage above and silver below, seemed bravely to symbolize the airline markings of potential users (in the covered exhibition, a section of 748 fuselage bears Aden Airways lettering). Next door to G-APZV in the static park stood two Buccaneers—Blackburn NA.39s wearing their new name (in bold white lettering) for the first time publicly.

Though not generically a newcomer to an SBAC Show, the Handley Page Victor B.2 was on view there for the first time; and parked next to it was the company's Herald demonstrator, G-APWA, with the flags of countries visited painted on its nose. Paint had played a part in "dolling up" several of the other aircraft on show. Thus the Short SC.1 appeared with fluorescent tips on wings and fin; there was the vivid orange of the D.H. Sea Vixen's refuelling probe, missiles and overload tanks; and historic "scalps" were depicted on the nose of the black Napier icing research Lincoln ("Are they still using these?" commented one passer-by)—Avro 748 and Comet wing test sections, among others. From the static park could be seen a lethal cluster of white RAF V-bombers at the western end of the airfield, and two Shackletons parked near the control tower were apparently brooding on the long night sortie they are making in a NATO exercise at the end of each day's flying display.

But it is not the static show of aircraft, nor the four green Army Thunderbirds and associated control complex mounted by 36 GW Regt, RA, nor the outside equipment display, nor the radar site, that make the biggest visual impact at this year's Farnborough: it is the big lettering "British Aircraft Corporation" and "Hawker Siddeley Aviation" on the outside of the enclosed exhibition, with each of the big group's missiles ranged in front, in a missile park that is larger than ever before. This year Thunderbird and Bloodhound share the same enclosure, as BAC products; and over against them—to use the sonorous Biblical phrase—are a black Blue Steel (which on Monday the ex-Minister of Supply, Mr Aubrey Jones, was examining with interest), Firestreak, a red CT.41 supersonic target, and a Seaslug mounted on a mock-up RN vessel, HMS *Successful* (with a real live Wren aboard)—all products or associated products of the Hawker Siddeley Group. Here was tangible evidence for the public—with the British Aircraft Corporation "on view" for the first time—of the new shape of Britain's aircraft industry, which in the 21st SBAC Flying Display and Exhibition is still consolidating its resources and girding its loins for future achievements.

ILLUSTRATED WITH "FLIGHT" PHOTOGRAPHS

Armstrong Whitworth AW.650 Argosy

TWENTY-FIRST SBAC SHOW . . .

Blackburn Buccaneers

Prototype Avro 748

"FLIGHT" PHOTOGRAPHS
near Farnborough last week-end

Folland Gnat Trainer

The Hunting Jet Provost T.4 gives "Flight" a foretaste of its display routine, though at rather higher altitude

TWENTY-FIRST SBAC SHOW . . .

The Aircraft

Armstrong Whitworth AW.650 Argosy (G-APRN) The Argosy on show is number four of the six aircraft that have been flown to date, four more being well advanced on the assembly line. This particular aircraft has flown about 600hr of the 2,000 (approx) Argosy hours flown to date—including 300hr of overseas route-flying carried out by AWA. The ARB full-category certificate of airworthiness is due in the very near future.

The rapid-loading virtues of the Argosy are well shown by a display of a complete Thunderbird missile, a Dart engine and assorted crates being "Rolamat-ed" in and out of the aircraft. Closer inspection of the system is possible in the indoor exhibition, where a large Argosy model (in the colours of BEA, who may well operate the aircraft) is the centrepiece of an impressive working display of AWA's "freight system."

Armstrong Whitworth AW.660 It was announced at the opening of the show that the Ministry of Aviation has ordered a further 16 of the Argosy's military variant, the 660. This will bring the strength of RAF Transport Command's future squadrons of these aircraft to 56. The aerodynamic prototype of the 660 was to appear on one or more days during the week.

Models on the Hawker Siddeley stand illustrate the increased width of flight deck and the doorless nose with its "pimple" radome for weather radar.

Auster D.4/108 (CS-AMA) Absent from the flying programme because of their American powerplants, the new Austers are nonetheless permitted to park statically throughout the show. The D.4 two-seater has a 108 h.p. Lycoming, and the red-and-white example at Farnborough is one of the large number of D.4s and D.5s on order for the Portuguese Government. Licence-production of a number of these aircraft in Portugal is probable. CS-AMA is fitted with long-span (36ft) wings, and is seen to have a useful baggage space behind its two seats.

Auster D.6/180 (G-ARDJ) Powered by a 180 h.p. Lycoming engine, the four-seat D.6 on show in the static aircraft park is extremely attractive, both inside and out. Improvements include full upholstery, new instrument panel, damped tailwheel spring and butyrate dope finish. Cruising speed is over 130 m.p.h.

Auster D.8 Project Not yet officially announced, but believed to be a probable forthcoming development, the D.8 would consist basically of a D.6 equipped with nosewheel landing gear and wider doors.

Avro 748 (G-APZV) The elegant pale blue styling of the 748 prototype is, apart from the name on the white top of the cabin, that of Skyways, who will be the first operator of the type. Delivery of the first of their three is planned for next March, and this operator will carry out the route-proving flying necessary for ARB certification. This may be between 200 and 300hr, depending on the progress of flight trials in the meantime. The aircraft on show has completed 66hr, having been in the hangar for a check one and adjustments following the completion of 60hr in the first four weeks of its flying life which began in June. Adjustments to the flying controls have been made, and the ailerons are now described as "spot on." The forward pair of mainwheel doors should be retracted when the undercarriage is down; they are not on this particular aircraft, pending a minor modification.

A second 748 is due to fly early in 1961, and certification may be achieved if all goes well by July 1961 to enable Skyways to inaugurate services at the peak of their summer season. The second customer, BKS, will take delivery of their two aircraft towards the end of 1961.

There are no airline seats inside the prototype aircraft on show, all the available untrimmed space being taken up with a temporary navigation station, four 90gal water ballast tanks (two forward and two aft for c.g. variation) and flight recorders.

In the indoor exhibition a complete fuselage section in Aden Airways colours is on show: the interior shows the compact yet adequately spacious two-by-two seating, and a two-pilot cockpit that is typical of the Skyways and BKS layouts.

Aden Airways will have the Series 2 aircraft with the uprated RDa.7 Darts, which will be first tested in one of the first two RDa.6 machines in the spring of next year. Materials for 30 production aircraft have been purchased by Avro in anticipation of orders, and the production programme is well under way.

The first Indian-assembled 748 is due to fly at Kanpur before

Another pre-display warm-up, this time by the Hawker Hunter Two-seater—with smoke and largest-yet (350gal) underwing tanks

the spring, the first of a "large number" of Indian licence - manufactured aircraft. Meanwhile project work on the 748M and 757 (military variants) and 758 (high-wing, rear loading version) continues.

Avro 771 This is the most recently announced of the new British transports and a model is to be seen in the indoor exhibition. Based on the twin Bristol Siddeley BS.75 ducted fan powerplant (2×7,350lb st thrust) the 771—like its competitor the British Aircraft Corporation BAC-107—is intended as a Viscount replacement for short-range regional networks. Seating capacity is 45 first-class or 60 economy-class in a cabin of 9ft 11in internal width and 6½ft minimum height.

Proportions of the aircraft are of interest: the small wing has an area of 800 sq ft, and leading edge high-lift devices are fitted to give take-off field performance of 4,800ft and a landing capability of about the same distance at the maximum landing weight of 50,000lb.

Maximum take-off weight is 52,000lb, and capacity payload is 12,000lb; this can be carried with full airline fuel reserve over stages of up to 500 n.m.

Design Mach number of the 771 is 0.82, and design cruising speed is 495kt (570 m.p.h.). Fuel tankage is 2,000 Imp gal. Price quoted, like that of the BAC-107, is less than £500,000.

The 771 is designed to have a rather higher cruising speed than the BAC-107, wing thickness varying from 11 per cent to 9 per cent and sweepback at ¼ chord is 30°.

Avro Vulcan B.2 (XH 534) This is the first pre-production Vulcan B.2 and is noteworthy for the greatly extended wing, nosewheel leg shortened by 18in, a refuelling probe in the nose, and the swollen tail which houses electronic equipment and an enlarged rearward-looking radar in addition to performing aerodynamic area-rule functions. Take-off boost rocket mountings are indicated. A large, unpainted metal plate bridging the gap between the starboard engine tailpipes beneath the wing might be a high-power or low-frequency or broad-band aerial, possibly radiating rearwards and possibly connected with ECM. Conversely it might form a heat sink to shift the centre of heat aft of the aircraft as an infra-red countermeasure. The plate is supported by a fore-and-aft vertical bulkhead and the duct formed between plate and engines is partly faired at the forward end and provided with a triangular intake. A second noteworthy innovation is the use of special pale reflective paint for insignia and serial number, reported to be connected with protection against atomic flash. This and the pinkish colour in which Vulcans are now being painted may indicate the use of heat-barrier rather than reflecting paints for greater protection from atomic flash heat—either from the aircraft's own weapon near the target or from enemy bombs exploding as the bomber leaves its base. The new paints, provided in this case by Cellon, might also affect infra-red wavelengths normally radiated from the aircraft.

Blackburn NA.39 Buccaneer (XK 488 and XK 489) Both these pre-production Buccaneers have braking parachutes stowed in the port airbrake section and both have new mass balance weights at each tip of the tailplane. On XK 489 the weights are streamlined while on the other aircraft roughly shaped weights are bolted on. XK 488 has a fixed tail bumper, but XK 489 retains the retractable hydraulic unit. Both have Martin-Baker ejection seats with strong extensions above the head-rests designed to allow ejection through the canopy. One Buccaneer flies past with its rotating bomb door in the open position. In the static display a wing section is shown (page 416) including forged ribs and integrally machined span-wise stringers. The super circulation air slots are formed by extruded channels. High Duty Alloys are showing a Buccaneer spar section forged in 2S99 steel. The massive proportions of these structural components indicate the strength required for low-level, high speed operations.

Boulton Paul P146 Investigations by Boulton Paul on behalf of the Ministry of Aviation have produced various VTOL configurations, one of which is shown in model form in the indoor exhibition. This is a 96-seat VTOL airliner incorporating 18 Rolls-Royce RB.153 lifting engines installed in pods of five at the extremities of the main swept wings and the canard noseplane. Forward propulsion is provided by three Rolls-Royce RB.163s installed aft. Range is about 500 miles.

Bristol Britannia There are no representatives of the commercial Britannia at the show, the aircraft now being out of production, although Bristol have one Series 310 available for early delivery. Shown on the British Aircraft Corporation stand is a model of the military transport version, the 253, of which some 20 are in service with RAF Transport Command.

Shown on the Bristol Siddeley stand is a Proteus 705 removed from a BOAC Britannia 102 and which has reached its allotted 2,400hr since overhaul.

Vulcan B.2. Mystery-fitting between starboard tailpipes—see col 1

Bristol Type 188 The complete slab tailplane of this supersonic research aircraft is on the Hawker Siddeley stand. Most joints are puddle-welded—fusion welding in an inert Argon atmosphere. Certain joints are by high-tensile steel bolts or jo-bolts (specially devised blind fasteners). Skins are taper-ground, varying between 0.1in mean at the centre and 0.04in outboard. Avica are showing swivel joints for the undercarriage and powered-control supply pipes in the 4,000lb/sq in hydraulic system. A 1/36th-scale model tested in the RAE Bedford 3ft×3ft supersonic wind tunnel shows the cascade-pattern air brakes designed to deflect airflow outwards rather than to present a solid airbrake surface. Four of these cascades hinge out from the rear fuselage.

British Aircraft Corporation BAC-107 A contender for the Viscount replacement market, and a short-haul jet aircraft that has been made possible by the exceptional economy of the BS.75 ducted fan turbojet, the BAC-107 has been jointly developed by Hunting Aircraft and Vickers, both now members of BAC.

Seating varies from 50 first class (four-abreast) to 59 economy class (six-abreast) in a cabin 10ft wide and with a headroom of 6ft 5in. Like its rival, the more recently announced Avro 771, the BAC-107 has a small wing (825 sq ft) in relation to fuselage size. Field length is quoted as less than 5,000ft and approach speed is 110kt. Design Mach number is 0.75, and a good maximum lift coefficient is achieved without recourse to special leading edge lifting devices.

The maximum payload is 12,000lb and maximum take-off weight is 48,500lb. Both maximum landing weight and maximum zero fuel weight, respectively 46,000lb and 41,000lb, are high proportions of the all-up. Fuel capacity of about 2,200 Imp gal gives maximum payload range with realistic airline reserves of about 435 n.m.

The first cost of the BAC-107 will be less than £500,000; this is less than the Viscount 810 and miles per gallon are actually less than those of the Viscount 700D.

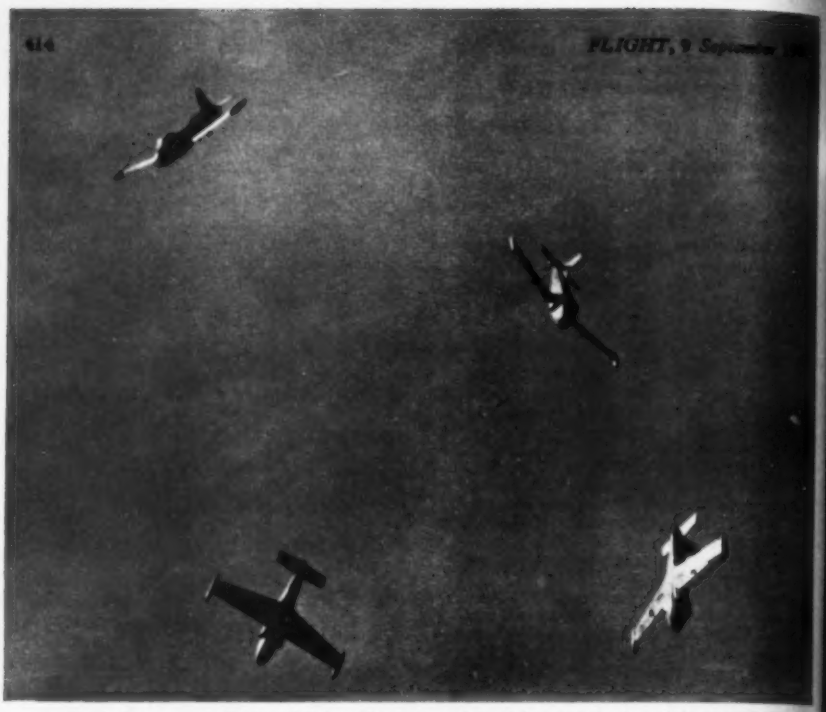
Canadair/Convair 540 Napier's most important commercial news of the show is Quebecair's order for two Eland-powered 540s. One has already been delivered. Meanwhile the type's first operator, Allegheny of the US, continues its highly successful operation (see page 405).

Of the RCAF's ten CL-66s (military version of the 540) the greater part are now in squadron service.

de Havilland Comet 2E (XN 453) RAE Farnborough is using this Comet to investigate sky-wave stable propagation characteristics of VLF radio transmissions with the aid of a Marconi ultra-stable, quartz crystal oscillator. Range measurements by phase detection can be obtained to an accuracy of three miles at Malta from Rugby GBR on 16kc/s and Griggion GBZ on 15.2kc/s. Balboa on 18kc/s will be used later. Worldwide naviga-

Handley Page claim that the Victor B.2 can be readily modified to carry four GAM-87A Sky Bolts, and this model shows four hypothetical ALBMs

This wooden tunnel model exhibited by Handley Page must closely resemble the HP.115 aerodynamic research aircraft, soon to fly on the power of a BS Viper



Finale for a superb display of flying: the downward bomb-burst of the four CFS Jet Provosts

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tion coverage could be provided with four transmitters on the equator and one at each Pole. Such a system has advantages over navigation satellites.

de Havilland Comet 4 series Although not represented at the show, except probably in the flying display should the production programme allow an aircraft to be spared, the Comet 4 is the subject of an important piece of news at the opening of the display. It is announced that the Ministry of Aviation are negotiating an order for five Comet 4Cs for RAF Transport Command. This brings the Comet 4 order book to 56 aircraft sold, airlines who have now taken delivery of the whole or part of their fleets being BOAC, Aerolineas Argentinas, BEA, Olympic Airways, Mexicana, East African Airways Corporation and Misrair.

Of special significance on the Rolls-Royce stand is an Avon 524 removed from Comet G-APDF on September 1 after having run 1,995hr without overhaul or unit change. It is to be reinstalled by BOAC after the show and run in service to 2,300hr before removal. The normal overhaul life is 2,000hr, the highest of any jet engine in airline service.

de Havilland D.H.121 Trident The first production aircraft, the company reports, now has its stub-wings mated to the fuselage on the Hatfield assembly line, and the tank test specimen is complete with wings and *in situ*. Project work goes ahead with the stretched, higher-capacity and heavier Mk 2 version for export customers requiring the higher stage length (up to 2,200 n.m.).

Twenty-four D.H.121 models on the stand provide an eye-catching reminder of the extent of BEA's investment in Britain's —and the world's—first high-subsonic short-range jet airliner.

de Havilland Dove 8 (G-ARDH) A face-lift for the familiar Dove is provided this year by a higher, Heron-type cockpit canopy and the increased power of Gipsy Queen 70 Mk 3 engines driving three-blade D.H. Hydromatic propellers. Inside the green-and-white exterior of this newly converted British demonstrator is a smart five-seat semi-VIP layout. Cockpit improvements, in addition to the increased headroom, include a restyled instrument panel. A batch of ten Dove 8s are on the line at de Havilland's Broughton (Chester) factory.

de Havilland Heron, Series 2D (G-APEV) Still selling, in these days largely as an executive transport, the Heron 2 (Gipsy Queen 30 Mk 2s) is represented by de Havilland's green demonstrator luxuriously trimmed in white and red as an eight-seater executive transport.

de Havilland Sea Vixen (XJ 578) This late production aircraft stands in the static park surrounded by a full range of stores. A Palouste starter pack is also there. The aircraft carries a refuelling boom, four Firestreaks and two 150gal tanks, all painted fluorescent red, with which it flies in the display. A new feature is the rain-shedding system by which compressor-bled air is ducted along the top of the fuselage and sprayed at high-speed along the windscreen. Boundary layer air is deflected away from the windscreen area by an extensive channel and masking fairing.

English Electric Lightning F.1 (XG 332) The Lightning shown both statically and flying is the standard model with a pair of Firestreaks and Ferranti Airpass. It is, of course, supported in the flying display by four Lightnings of No 74 Sqn. It is stated that the Lightning is also suitable for ground-attack.

English Electric Lightning T.4 (XL 629) The second T.4, this machine has extensive flight test equipment in the dorsal spine and, temporarily, no Airpass. It will fill both operational and training roles.

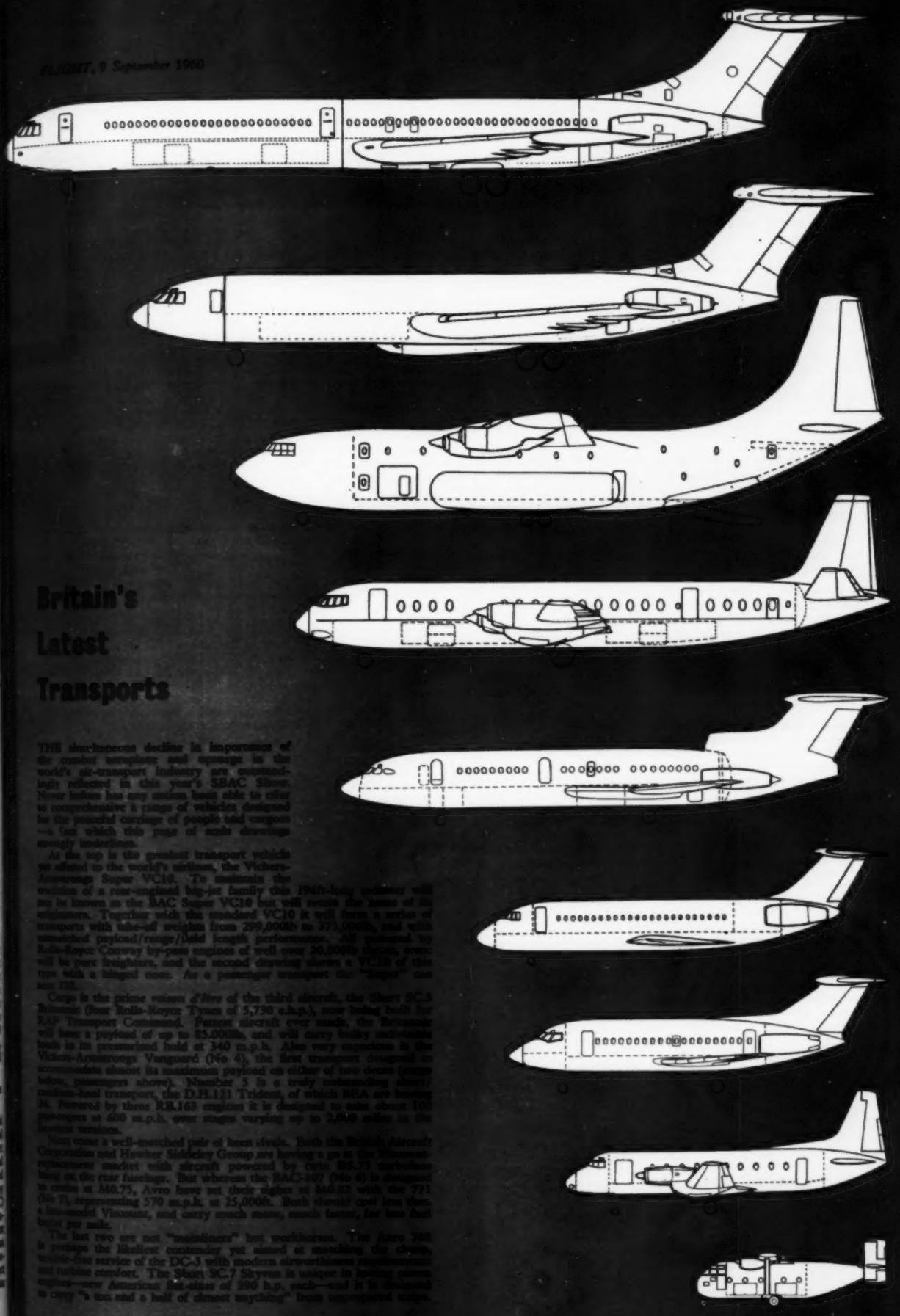
Folland Gnat Trainer (XM 691 and XM 693) Of the six Gnat Trainers now flying the first and third are at Farnborough, the latter machine with full dual control, two ejection seats and blast shield for the rear occupant. Definitive flight instruments are not yet fitted. The first of these aircraft to have integral tankage in the wing is number four, XM 694. Shown for the first time in the static park are Aden gun streamlined containers attached to the fuselage flanks by pylons which house the feed chutes for 130 rounds of ammunition per gun. Also shown are underwing tanks, twin rails for 12lb or 60lb 3in rockets, rocket packs and 1,000lb and 500lb bombs.

Gloster Javelin FAW.9 (XH 844) The only visible innovation in this FAW.9 is a third row of turbulators on each wing.

Handley Page Dart Herald (G-APWA) Due to be delivered to BEA towards the end of January, with the two others ordered by the Ministry of Aviation due to follow in February, the Dart Herald is due to be certificated by the end of 1960 at an initial all-up weight of 39,000lb, 40,000lb being expected to be approved shortly afterwards. Flight tests have shown that certification may be expected at 39,000lb in tropical temperatures (ISA+30°C) compared with the ISA+22°C previously expected. Performance at 40,000lb can be maintained at ISA+13°C. The Dart Herald in the show is the first production aircraft, which has shared with the converted G-AODF extensive world demonstration tours—as the 57 flags on G-APWA's nose testify. Dart Heralds have now flown some 2,000hr and the firm emphasizes

(*Continued on page 416*)

Britain's Latest Transports



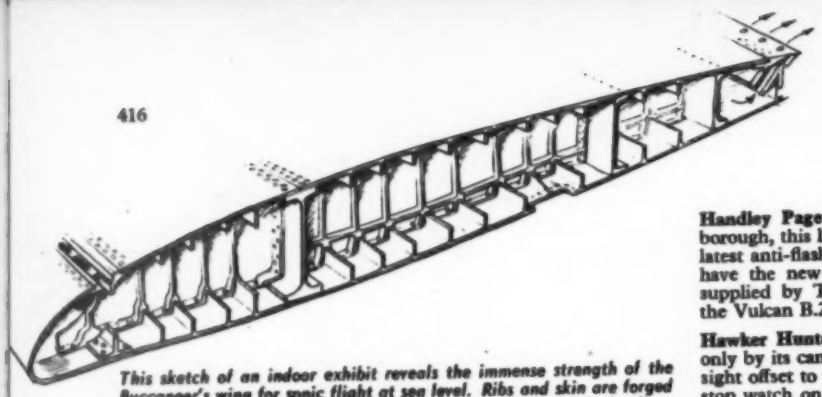
THE simultaneous decline in importance of the comfort aeroplane and upsurge in the world's air-transport industry are outstandingly reflected in this year's SBAC Show. Never before has any nation been able to offer so comprehensive a range of vehicles designed for the powerful carriage of people and cargoes—a fact which this page of scale drawings strongly underlines.

At the top is the greatest transport vehicle yet offered to the world's airlines, the Vickers-Armstrongs Super VC10. To maintain the tradition of a rear-engined big-jet family this 1960's-born successor will not be known as the BAC Super VC10 but will retain the name of its predecessors. Together with the standard VC10 it will form a series of transports with take-off weights from 299,000lb to 373,000lb, and with unmatched payload/range/field length performances. All powered by Rolls-Royce Conway by-pass engines of well over 20,000lb thrust, every one will be pure freighters, and the second drawing shows a VC10 of this type with a hinged nose. As a passenger transport the "Super" can seat 222.

Cargo is the prime reason d'être of the third aircraft, the Short SC.5 Belfreight (four Rolls-Royce Tynes of 5,730 e.h.p.), now being built for RAF Transport Command. Largest aircraft ever made, the Belfreight will have a payload of up to 85,000lb, and will carry bulky and awkward loads in its pressurized hold at 340 m.p.h. Also very capacious is the Vickers-Armstrongs Vanguard (No 4), the first transport designed to accommodate almost its maximum payload on either of two decks (cargo below, passengers above). Number 5 is a truly outstanding short-medium-haul transport, the D.H.121 Trident, of which BEA are launching 24. Powered by three RB.163 engines it is designed to take about 100 passengers at 600 m.p.h. over stages varying up to 2,000 miles in the longest versions.

Next come a well-matched pair of keen rivals. Both the British Aircraft Corporation and Hawker Siddeley Group are having a go at the short-to-medium-haul market with aircraft powered by twin BS.75 turbofans hung on the rear fuselage. But whereas the BAC-107 (No 4) is designed to cruise at M0.75, Avro have set their sights at M0.82 with the 771 (No 7), representing 570 m.p.h. at 25,000ft. Both should cost less than a jet-engined Viscount, and carry much more, much faster, for less fuel burnt per mile.

The last two are not "mainliners" but workhorses. The Avro 748 is perhaps the likeliest contender yet aimed at matching the cheap, trouble-free service of the DC-3 with modern airworthiness requirements and turbine comfort. The Short SC.7 Skyvan is unique in having prime engines—new American flat-rates of 390 h.p. each—and it is designed to carry "a ton and a half of almost anything" from unprepared strips.



This sketch of an indoor exhibit reveals the immense strength of the Buccaneer's wing for sonic flight at sea level. Ribs and skin are forged and machined and supercirculation ducts are clearly seen (the leading-edge duct minus its shroud)

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the "product-improvement" value of the world tour programme.

Emphasized at the HP stand in the indoor exhibition is the developed Herald with a 42in fuselage extension, permitting 50 seats with 340 cu ft of all-cargo space and buffet, or 56 seats (of compact design) with 192 cu ft without buffet. The BEA version will be a 44-seater.

Handley Page H.P.115 Despite pre-Farnborough prognostications, the only indication of the H.P.115 configuration to be revealed is "a wind tunnel model used in a supersonic research programme," displayed on the Handley Page stand. The wooden model has a very narrow delta wing with sharp leading edges and the pilot's cockpit forms a bulge at the extreme nose ahead of a slender cylindrical fuselage. A turbojet, presumably the Viper, is housed in a pod on top of the rear fuselage, beneath the fin. Elevon control surfaces occupy the entire trailing edge.

Handley Page H.P.117 A model and a diagram in the exhibition show a 300-seat layout for this all-wing subsonic airliner project. No data are available, and the only figure that is published is the remarkable claim that the economy of this laminarized aircraft will be such as to make possible an £11 transatlantic fare.

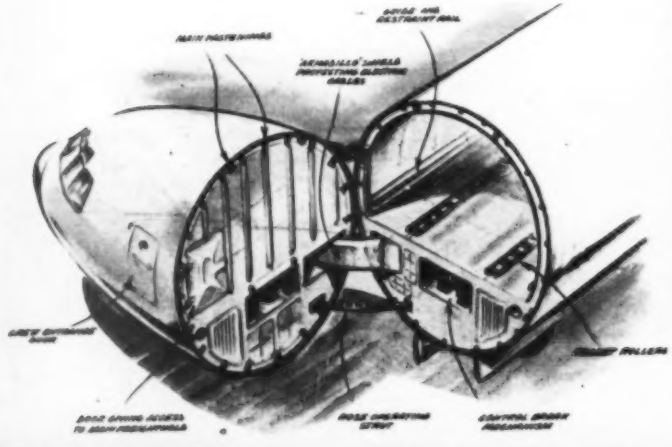
Near the model are examples of skin materials developed for boundary-layer control—sintered nickel, pinhole and slit-surface, the last-named being probably the most likely method.

Handley Page HPR.8 Exhibited for the first time by Handley Page, having hitherto been referred to only by Silver City Airways, the HPR.8 is exhibited in model form in the indoor exhibition. It is capable of accommodating six cars and 30 passengers, or more than 100 passengers, the front clam-shell doors becoming a panoramic observation window in the all-passenger version.

It seems likely that the HPR.8 will have the higher powered Dart engines. Unit price is about £250,000 and the project is being considered by Silver City together with the AW.670 Air Ferry. The HPR.8, as is obvious from its appearance, incorporates a great many components and systems of the Herald.

Handley Page Supersonic Airliner In the indoor exhibition is a model of a Mach 2.2 narrow delta supersonic airliner project employing boundary layer control. Full laminar flow is claimed to increase range by 29 per cent and reduce costs by 21 per cent compared with non-laminarized supersonic airliners.

Design details of the swing-nose VC10 and Super VC10 freighters are revealed in this drawing from Vickers-Armstrongs



Handley Page Victor B.2 Seen for the first time at Farnborough, this latest mark of Victor, like the Vulcan, is to have the latest anti-flash paint treatment. All models in the static display have the new pale reflective-paint insignia. Paint finishes are supplied by Titanine and the same considerations apply as to the Vulcan B.2.

Hawker Hunter FR.10 (XG 168) Externally distinguishable only by its camera nose from the FGA.9, the FR.10 has the gun-sight offset to the right, leaving room for UHF radio selector and stop watch on the left of the coaming. Marconi miniature ADF and drag parachute are standard and the flight instruments are re-arranged to facilitate quick reference during high-speed, low-level flight. Aileron gearing can be changed to reduce sensitivity at high speed, low down. The full range of underwing stores can be carried.

Hawker Hunter Mk 66 Two-seater (G-APUX) This red and white company demonstrator arrived at Farnborough carrying two 350gal ferry tanks made by inserting two 3ft sections into each standard 230gal ferry tank. The sections can be removed to revert to 230gal capacity and this tank now has a lateral bracing strut and is stressed to 7g so that it can be carried during ground-attack missions. G-APUX has a nosewheel brake, drag parachute, two fixed Aden guns and can carry the full Hunter range of stores and R.F.D. towed-target containers.

Hunting Jet Provost T.4 (XN 468) Externally the T.4 is virtually indistinguishable from the T.3 but has the Viper 11 which affords almost 100kt increase in top speed and much improved climb and ceiling. Conversely, operation at Viper 8 power results in considerable fuel economy. Underwing stores and rifle calibre machine guns can be fitted but are not provided in T.4s for the RAF. A Jet Provost T.3 (XN 462) is in the static park with bomb and rocket loads typical of the armed Mk 51 export version already supplied to Ceylon.

Lancashire Prospector (G-ARDG and G-APXW) Of the two Prospectors at Farnborough, the one in the flying display, the all-yellow G-ARDG, is powered by a 410 b.h.p. Cheetah 10 radial engine and is designated the prototype Mk 2. Standard spray equipment is carried—and demonstrated. The second example is G-APXW, located unexpectedly in the equipment park and powered by the 295 h.p. Lycoming standard in the Mk 1 Prospector. A model illustrates a floatplane version which will be the company's next development.

Scottish Aviation Twin Pioneer 3 (G-APPH) On show is Scottish Aviation's demonstrator fitted with the direct-injection Alvis 531 engine of 640-650 h.p. This provides 100 more horse-power per engine than the standard aircraft powerplant (Alvis 514) to improve engine-out performance and also payload-range capabilities. Slightly more miles per gallon are claimed to be achieved also. The aircraft is fully certificated at 14,600lb and about 80 Twin Pioneers have now been built, 36 of these for the RAF.

Short SC.1 (XG 905) This, the second SC.1, is within six flights of the completion of its test programme. About 100 transitions have now been made and the first SC.1 will shortly be handed over to RAE for tests directed towards automatic transition and landing. The SC.1 is the first aircraft to have flown extensively relying solely on a triplex autostabilization and control system. Two genuine channel faults have been experienced at or near the hover and in both cases the remaining channels successfully over-powered the faulty channel.

Short SC.5 Britannic Models in the static display illustrate the variety of loads which this heavy freighter can carry.

Short Skyvan In the indoor exhibition is an actual fuselage section of this new light freighter aircraft, of which full details were published on the eve of the show (*Flight*, August 26 and September 2). The assembly shows clearly the way in which the structure is composed of an outer skin smoothly bonded to, and stabilized by, a corrugated internal skin. The outside finish is seen to be remarkably unwrinkled and unriveted for an aircraft of this relatively large surface area.

Though weighing no more than a Dove, the Skyvan's large internal volume is evident from this big 6½ft by 6½ft section, which incorporates one of the "henhouse" hatches that enable loads to be lashed to the floor from outside the aircraft to save walkway space inside. There is also a model on the stand.

The new "30-cwt van" is powered by two Continental 390 h.p. piston engines which will be manufactured in this country by Rolls-Royce.

Short VTOL Fighters Most recent of a series of lightweight VTOL strike fighter projects suggested by Short and shown in

model form is the PD.49, a single-seater with a Draken-like double-delta wing and a single large propulsion engine—a configuration indicative of supersonic capability. A battery of lift engines is mounted in the centre fuselage. Shorts are urging adoption of a VTOL fighter to gain operational experience for eventual civil operations.

Vickers Super VC10 A further 10ft stretch of the Super VC10's fuselage—the length of the Super version for BOAC being already 28ft longer than that of the standard VC10—was apparent from new data announced at the opening of the show. Maximum all-up weight of the "developed Super VC10" goes up from the 347,000lb of the BOAC Super version to 360,000lb, and seating accommodation (maximum six-abreast) is up from 212 to 222.

This notable development of the payload/range capability of the Super VC10 has been made possible by further exploitation of the clean high-lift wing, and yet further Rolls-Royce Conway thrust potential. The developed Super VC10 has the RCo.42 Conway 7 of 24,000lb thrust—or the Allison AR.972-2 version.

A large US operator has reportedly been showing interest in the Super VC10, and it is reasonable to expect that the airfield performance made possible by the rear-engined configuration gives the aircraft a commercial payload/range potential which, runway for runway and power for power, should always be one step ahead of that of the big American jets.

The large Super VC10 model exhibited on the British Aircraft Corporation stand is actually the BOAC version, 28ft longer than the standard VC10, a model of which is alongside it.

Vickers Super VC10 Freighter In the indoor exhibition is a model of this window-less swing-nose (starboard-side hinge) all-freight transport, which has a payload/range capability of 106,000lb over 2,460 n.m. with full fuel reserves. With 60,000lb, range including reserves is 3,950 n.m. Maximum take-off weight is 373,000lb, and the structure is strengthened where necessary.

The model shows a train of pre-loaded pallet-containers being rolled along tracks into the 8,832 cu ft fuselage by means of a mobile, adjustable-height dock.

A notable advantage of the swing-nose concept, thanks to the nosewheel, is the absence of any "propping" requirement to prevent the tipping that can occur during rear-loading.

Vickers Vanguard V.952 (CF-TKB) On show is the second of 23 Vanguard 952s ordered by Trans-Canada Airlines. This is one of two TCA aircraft which, with a V.951 Vanguard, is on test with Tynes that are temporarily limited to 50hr, pending correction by Rolls-Royce of a fault discovered in the Tyne compressor. Rolls have delivered three sets of interim engines, plus two spares, to Weybridge to enable continuation of the flight development prgoramme. It is expected that TCA's aircraft will be delivered early in the new year, following the handing over of one or two BEA aircraft before the end of the year.

The interior of the aircraft on show is strikingly appointed by the airliner interior stylist Charles Butler. Gold trimmings, including maple leaves on the ceiling, abound and the seats are in salmon pink and soft blue picked out with gold thread. Total seating is for 96, the first-class cabins accommodating 46 four-abreast, the tourist accommodation being for 50 five-abreast.

A number of turbulators have appeared on the Vanguard on the upper wing between the port inner nacelle and the fuselage, though there are none in the corresponding starboard position. A strip of vortex generators also appears forward of, and running the full span of, each aileron just forward of the upper hinge line.

In the indoor exhibition the Vanguard is described as "the most economical and flexible medium-haul airliner ever built."

Vickers Viscount Though there are no representatives of this best-selling (429) turboprop airliner at the display this year, there is a reminder on the Rolls-Royce stand that the Dart engine has now completed 12 million hours' flying in airline service; the overhaul life (for TCA's Dart 506s) is now up to the unprecedented figure, for an airline engine, of 3,000hr.

Westland Belvedere (XG 451 and XG 452) These two specimens of the Gazelle-powered helicopter previously known as the Bristol 192 differ in a number of respects. The first, which participates in the flying display, has wooden rotor-blades, small wheels, an anhedral "barn-door" tailplane, manual controls, a vertical stabilizing wedge on the trailing edge of the rear rotor pylon, and an interior which includes a carpeted and curtained VIP-lounge section with five seats and extra soundproofing. In contrast, 452 has metal blades, large wheels, a higher-mounted, cranked tailplane (the final production version), single powered controls with manual reversion, an offset trailing edge to the pylon, and an interior filled with test instrumentation. It has completed tropical trials in Libya and high-altitude tests in the French Alps,

Proclaiming its identity on its yellow fabric is the first Mk 2 version, with an Armstrong Siddeley Cheetah 10 engine of 410 h.p.

while XG 451 is undergoing mission and radio trials at Boscombe Down. The delivery of the first three Belvederes to the RAF at Odiham was imminent at the beginning of Farnborough week.

Westland Rotodyne (XE 521) The Eland-powered prototype was due to fly over from White Waltham daily to take part in the flying display, but did not appear on Monday. Differences compared with its appearance last year are the recently acquired central fin; a redesigned, more flexible rotor pylon; and a number of detail design modifications which have recently been incorporated. Over 300 flights have been logged by XE 521, while detail design of the larger, Tyne-powered production version is now well advanced. On the company's stand in the static exhibition a Rotodyne model is displayed in conjunction with a model of a hypothetical London heliport spanning the Thames between Waterloo and Blackfriars bridges.

Westland Skeeter (XM 563) This Army-camouflaged helicopter is a Mk 12 which has been fitted experimentally with a 425 h.p. Blackburn Turmo 603 free turbine derated to 250 s.h.p. It has provision for the evaluation of three-channel autostabilizer equipment.

Westland Sprite (XN 334 and XP 165) One of the Royal Navy's evaluation batch of three P.531 Mk 0 aircraft, XN 334 is Turmo-powered and carries two USN Type 43 homing torpedoes beneath its fuselage. Exhibited in Army camouflage, XP 165 is a true Sprite, powered by a Blackburn A.129 Mk 3 Nimbus and is representative of the development machines recently ordered by the Ministry of Aviation. This version has a longer body, restyled cockpit and instrument panel, redesigned control circuits, external drive shaft to the tail rotor, and simplified mounting of the skid-type landing gear. The folding tail featured on XN 334 is not retained on the Army Sprite.

Westland Wessex (XM 839) Although the main function of the Gazelle-powered Wessex Mk 1 in production for the Royal Navy lies in the anti-submarine role (both detection and strike), the specimen at this year's show is equipped solely as a transport, with 14 canvas seats fitted along the cabin sides. It has Newmark autostabilization for all-weather operation.

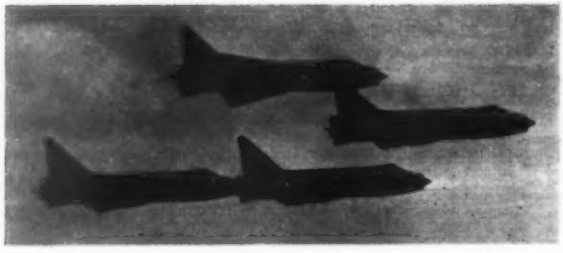
Westland Westminster (G-APLE) Like the Rotodyne, the Eland-powered prototype Westminster is based at White Waltham for the period of the display, flying over to Farnborough each day to show itself as part of Westland's helicopter circus. Main external difference since last year is the fabric skinning, said to represent the outline of a possible 40-seat transport version. Included in the development flying programme since the 1959 display have been six-blade rotor trials and vibration checks throughout the speed range up to 130kt. There is now a tailplane.

Westland Whirlwind (XJ 398) With over 200 hours of Gnome-powered flying in its log-book at the beginning of Farnborough week, XJ 398 is one of two Gnome Whirlwinds built to date. The second has totalled some 100hr. Now under construction at Yeovil, the third example will be truly representative of the Mk 10 version on order for the RAF.

The second Short SC.1 in jet-supported flight, with main legs in the aft position and lift-jet ram intake open

TWENTY-FIRST SBAC SHOW . . .

An incomparable array: the Westland helicopter range



The English Electric Lightning F.1s from 74 Squadron

MONDAY'S FLYING

THERE can be no serious disagreement that this year the Farnborough laurels should rightly adorn the static tent. People who have come looking for a variety of new aeroplanes are expressing disappointment—foolishly, considering the advance notices; and often churlishly. But if, after reading this account, an impression is left that this year's flying display is an unworthy one, then a heavy measure of blame must lie with the writer.

There is nothing like the excitement of a scramble to set off a flying show in the right style, and Bomber Command are obliging this year in massive fashion. The changes were to be rung throughout the week between the three types of V-bomber, and Monday was a Valiant day, the designated unit being No 148 Sqn, based at Marham, Norfolk.

Four wing-tanked B.1s stood like ivory pawns in a grim game of chess—ready to illustrate reaction time of the deterrent. On orders from the Commander-in-Chief, Bomber Command, a controller gave the word. A mortar thudded from the president's enclosure. The quadruple Avons were started as one. Ground crews pulled clear the starter trolley leads, made themselves scarce. The Valiants were rolling. First man off in 1min 6sec. Elapsed time 1min 56sec. And that was that—the marvellous integration of men and machines that is Bomber Command, 1960.

In the annals of the Flying Display, 1960 must be written, above all, as the year of jet lift. True, many years have passed since the Rolls-Royce Flying Bedstead demonstrated the feasibility of the technique; but at Farnborough 1960 the Short SC.1 is displaying the full range of manœuvre implicit in the Griffith formula.

As an aeroplane this VTOL research aircraft looks unattractive; and it sounds worse. But we saw it on Monday as a squalling infant that may yet become the sire of an entirely new race.

Overalled figures danced attendance on the prodigy, which rose straight up, hovered, moved sideways, pivoted on its axis, returned, hovered, accelerated with sharp decision, and within seconds was climbing at fighterish speed. Returning from a circuit, it slowed its pace with the noise and firm resolve of an express entering the confines of a station. Then, having swivelled through 360 degrees, it lowered itself out of the air in its own good time, to settle from view behind the president's tent. It taxied away like any normal aeroplane towards Laffan's Plain.

In STOL, as well as VTOL, Britain has pioneered—in name as well as in fact; for the Twin Pioneer is British still, though hailing from Prestwick. On Monday the demonstrator was a new Series 3, with long-stroke Alvis Leonides, the port example of which was feathered at take-off. The essence of the demonstration was in repeated turns against the dead engine; and this was unfeathered only for landing. This performance was proof of greater power, as were the manœuvres of the Hunting Jet Provost T.4 which followed. Under the inspiriting influence of a Bristol Siddeley Viper of some 2,500lb thrust (the Viper in the Service T.3 gives 1,750lb), the "JP" unstuck quickly and was held down for a vertical zoom, to position for a classic exposition of classic manœuvres, culminating in a six-turn spin.

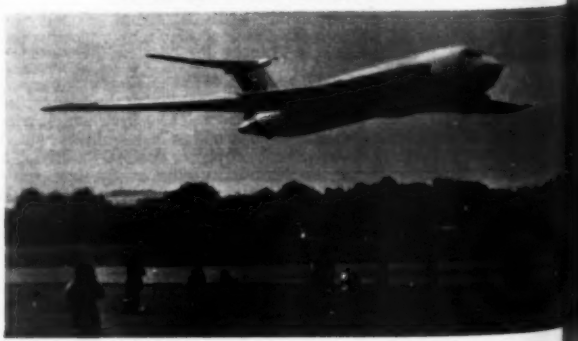
When one uses the word classic in relation to flying one usually has in mind the Central Flying School; and with two pairs of Jet Provost T.3s the CFS displayed on Monday a standard of co-ordination and synchronization for which we can recall no parallel. Concerning this altogether original and exceedingly pretty performance we hope to say more in our next report. Pictures herewith are a mere appetizer.

Lancashire Aircraft's Prospector Series 2—that is the new version with the Cheetah engine—was on Monday a little handicapped (though hardly noticeably) by an airscrew of fixed, and not entirely suitable, pitch. On its simulated crop-spraying run it reminded us of the corporation watercart, though it offers a wider application than that useful vehicle.

Handley Page gave real substance to their short-field claims for the Herald, the substance being 30 parachute troops, who, the Herald having presented itself before them with the port Dart at rest, were able to nip smartly aboard without undue risk of decapitation. Then, measured between tapes, the Herald got away in under 600 yards, and returned to land within the same distance.

A non-starter last year, the Victor B.2 made its presence surely

Presenting the Handley Page Victor B.2



felt and heard on Monday. From Laffan's Plain it came rearing up out of its efflux haze like a monstrous ray out of the sea, strangely beautiful to the eye but cruel to the ear. One slow pass seemed the merest gentle brushing of the runway with its wings. Then once again the cataclysm.

With queenly quiet came the Vanguard; yet with light moments on its climbing turns and with its regal progress a little sullied (sad to add) with Tyne-smoke. This TCA liner looked fast in the air and, with full reverse thrust, fast-stopping on the runway.

Name it in the turbine helicopter line and Westland can probably produce it over the counter; and on Monday they set out their wares in the manner of people who mean business. The Skeeter with Turmo, the Sprite and the Wasp, the Belvedere, the Wessex, the Gnome-Whirlwind and the Westminster, rose in unison. Our picture conveys more than could words the extent of this unique range of helicopters and is symbolic of the new group's marketing front. The Wessex went gay as always. The Rotodyne, though programmed, was absent.

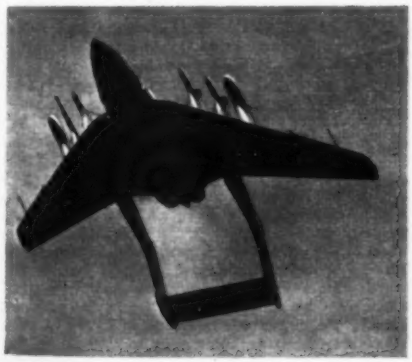
The de Havilland Dove 8—that neater, cleaner, more desirable Dove—flew past in the manner of an executive aeroplane going a journey. Which was seemly.

In the Argosy and Avro 748 Hawker Siddeley put up a companion pair of Dart-powered contenders for world business. On its low runs the Argosy glinted chunkily, bespeaking capacity reconciled with performance. The 748 lined up, wound up a little shrilly (it is hardly Viscount-quiet, by reason of its larger propellers) and, looking notably dainty in blue and white and silver, and even more notably so when cleaned up in the air, presented its high-aspect wing in climbing turns. Its three automatic observers, one learned, were observing away throughout the proceedings.

The Vulcan B.2 may be wearing its roundels pale this year, but there is no suggestion of loitering, about this knight at arms. On Monday it astounded in everything it did: in its fantastically steep climbs, straight and corkscrew; in the breath-stopping shut-offs of Olympic power; in the smoking, rushing, ripping, relentlessness of its low passes. And not least by its landing—astonishingly short, though unbraked by tail-chute.

If we do not dilate on the presentation of the Javelin 9 it reflects no discredit on the pilot, who indeed gave the usual rip-roaring performance, with the Javelin brandishing its four Firestreaks all round the sky. And of the Sea Vixen we shall say little more than this: that while it may still go supersonic at a touch of the stick, even with decks cluttered for action, it now displays the purity of form of the Fairey Flycatcher. Vapour-shimmy marked an extremely fast low pass, and the fluorescent Firestreaks, tanks and refuelling probe flashed luminous in the rapid rolls. A mighty fighter.

Aspect of de Havilland Sea Vixen



Likewise of the Folland Gnat Trainer there is little to say anew, though still much to marvel at in respect of acceleration, rate of roll and radius of turn. Nor shall we be invidious in respect of the two Hunters, a fighter reconnaissance FR.10 this year, together with the 66A two-seater. It must be reported, however, that on Monday the 66A's spin-with-smoke (ten turns?) was rendered the more dramatic by intervening cloud. Commentator Oliver Stewart gave the thought-provoking explanation that, after the spin is established, the stick is pushed forward, which slightly increases the rate. In tractability and tactical capability alike the Hunter continues supreme in its class.

Two bold Buccaneers from Brough looked more like playful dolphins—though uncommonly fast even for that species—as they dived in for a joint splash and parted company port and starboard. The piscine impression was heightened by impartially executed, extremely fast, extremely slow, and extremely low rolls, and sustained inversions. The structural strength of the Buccaneer is attested by a sketch on an earlier page. Low-level manœuvrability was sensationally established over the airfield.

The Lightning F.1 and T.4, those sharp-winged, rectangular blocks of scarifying power, excelled again in their characteristic and hardly conceivable "square corner" turns. Incomparable? In this attribute demonstrably. Operational? No 74 Sqn from Coltishall gave answer with a tight clutch of four in runs at 360 knots—and upwards. Nothing fancy but, on the contrary, something solid, proclaiming M2 in a hitherto M1 Service.

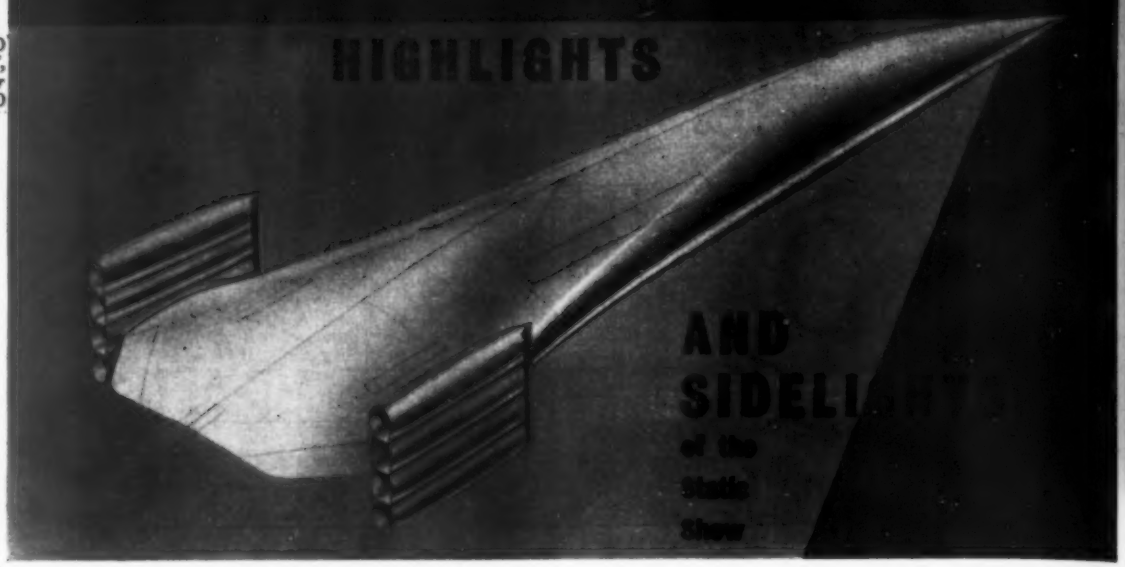
To seek new superlatives for Treble One would be futile, if only because the squadron's history-making show-team will disband after this display to re-equip with Lightnings. But on Monday they showed transcendent form—and gave palatable lessons in aircraft recognition. They made their entry—all eighteen of them—with what their spokesman described as a Pterodactyl loop; and we wondered how many among them were aware that the prototype of the vast tailless shape they were forming in the Farnborough sky was floating around in that self-same sky the best part of 40 years ago. Emitting smoke, they split into their component nines, one element forming the "Treble One loop." A detailed recapitulation of their routine would do scant justice to a performance having its essence in rhythm and drama; and candidly we failed to get it all noted down, so fast was the action. But we must not fail to record the Farmer loop, wherein nine Hunters enter the loop in the Treble One formation and emerged from it in an arrow, representative of the Soviet fighter so code-named. Then came the Draken and the Voodoo, to bring in Sweden and the USAF—manœuvres supported by the wine-glass, diamond nine, big seven, five card, and other tricks of the Farnborough fairground. The pay-off—not counting the stream landing which is thrown in as a bonus—was a double Pterodactyl loop, with a break into nines after the first, and a two-way bomb-burst, with one formation breaking upwards through the downward-breaking smoke-trails of the rest. Six Hunters landed within 35 seconds; nine within 60; twelve within 90; all within 150.

A lone grey Shackleton MR.3 of 201 Squadron, St Mawgan based, set out to demonstrate *in absentia* the Atlantic patrol capability of Coastal Command by remaining airborne for some 22 hours, before returning at the beginning of the next day's flying. Faced with an all-night vigil of its own, wherein to pound out the incalculable wordage of this Farnborough report, *Flight's* editorial team felt less, perhaps, than most onlookers for the lonely crew—in their snug stations, with mugs of steaming cocoa and the progress of only one aeroplane to report.

But the hour is late, and we digress.

Treble One, with Lightning on approach

HIGHLIGHTS AND SIDELIGHTS of the Static Show



Rolls-Royce project for a Griffith-type supersonic transport

Engines

A lightplane turboprop From the highly developed 1S/60 turboshaft engine —used in an airborne auxiliary powerplant in RAF service at up to 50,000ft—Rover Gas Turbines Ltd are evolving the TP.60 and TP.90 turboprops as complete packages for light aircraft. Features of the basic unit are a centrifugal compressor, single-stage free-reaction axial turbine and reverse-flow tubular combustion chamber mounted above the rotating assembly. Rover have developed a propeller hub in which pitch is governed by engine r.p.m. and the position of the power lever, and this will form part of the final powerplant. The TP.60 is being rated at 70 h.p. for take-off and 60 h.p. for continuous cruising, while the TP.90 will have a take-off rating of 100 h.p. and continuous rating of 90 h.p. Both will be 49.6in long, 20in wide, 27.6in high and have a weight of 235lb complete with propeller, cowling, oil cooler and car-type starter and belt-driven generator. Although a private venture, Rover have put these engines forward to the MoA as alternatives for consideration by the committee for aid to light-aircraft designs—and, since all the other engines are imported, the proposal has been accepted. Rover are putting an engine in the nose of a light twin, and it is hoped to demonstrate the machine at the Paris Salon next May. Selling price of production powerplants will depend upon ARB requirements, but Rover hope it will be of the order of £1,500.

The optimized BS.75 turbofan Naturally enough, since they have yet to run one, Bristol Siddeley Engines are loth to say too much about likely customers for this medium-sized turbofan. Nevertheless, it has been sized with singular acumen, and appears to be likely to dominate the entire field needing engines smaller than the Rolls-Royce range (which goes down to 9,850lb). Design take-off thrust of the 75 is 7,350lb, as we were able to reveal in our August 12 issue.

Here we are able to publish a longitudinal section—what the Americans call an "inboard profile"—which reveals the configuration adopted. The earlier BS fans are to some extent designed to make use of major assemblies developed for earlier straight jets. Although this makes for rapid and cheap development, and may improve the time-between-overhauls picture, Bristol Siddeley have not compromised their new engine in any way—although the fan and the turbine respectively owe a lot to the Olympus and Proteus. The low-pressure assembly (solid black in the drawing) consists of three fan stages driven by a two-stage turbine, and the high-pressure unit comprises a ten-stage compressor again driven by a two-stage turbine. As distinct from Rolls-Royce and Pratt & Whitney practice, the fan is divorced from the compressor, and in view of the basic ratios chosen this is the obvious thing to do.

These basic ratios are: pressure, 13:1; by-pass (cold divided by hot), 1.75:1. The latter is well over the "around unity" suggested by Rolls-Royce as offering the best compromise between low specific consumption, noise and installed drag and weight. Certainly the brochure figures for the Bristol Siddeley unit are remarkable: take-off rating, 7,350lb; corresponding s.f.c., 0.508 (lowest consumption yet claimed for any jet-propulsion engine); dry weight, 1,485lb; and s.f.c. at M0.75 at 30,000ft, 0.76. Moreover, there is nothing "near the knuckle" about the engine; the all-important criterion of turbine entry temperature is modest, and some 40°C under that to which current blade materials are being cleared. Those engineers at Patchway are worth watching.

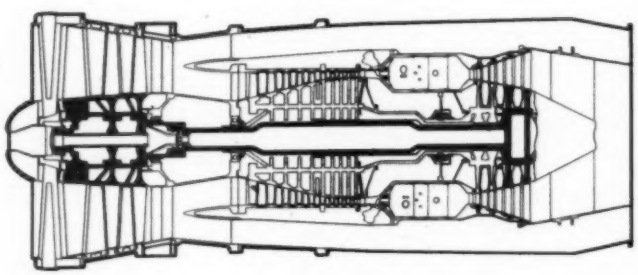
Propulsion for VTOL Although barred by security from showing new hardware, Rolls are making a special feature of jet lift, particularly in its application to supersonic transports along the lines formulated by Dr A. A. Griffith. A large pictorial display starts with a facsimile of an original 1945 drawing—by Donald Eyre, one of Griffith's colleagues—for a supersonic tail-sitting fighter. It continues with the "Bedstead" and SC.1, and concludes with a future long-range transport configuration. Thrust/weight ratios have risen from 3.2 (Bedstead Nene, 1952) through 6.6 (Soar, 1952) and 8.1 (RB.108, 1955) to 16 in a modern lift engine (the model of which suggests a high airflow and minimum length).

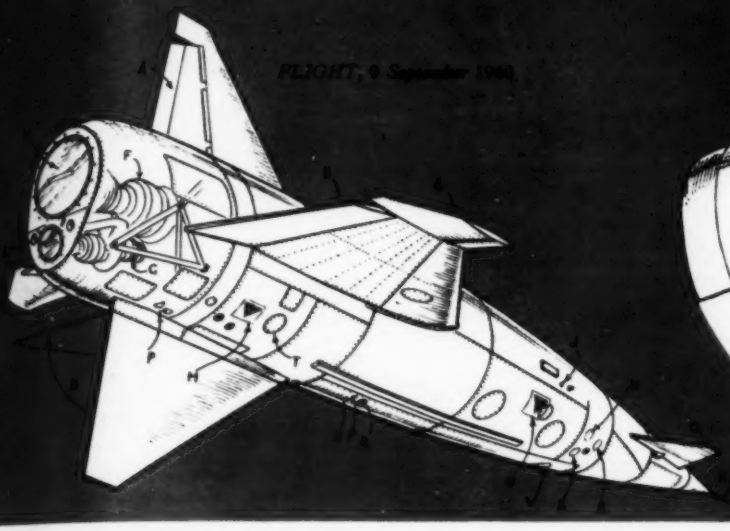
—and for supersonics Bristol Siddeley are exhibiting simplified drawings of propulsion systems suitable for aircraft designed to cruise at supersonic speed. Drawn against slender-delta airframes are systems for M2 (unreheated turbojet, derived from the Olympus), M2.5 to 3.5 (duct-burning offshoot of the BS.53 turbofan—an example of which may be seen gaily pivoting its four nozzles) and M4.5 (turbojets of Orpheus appearance matched with ramjets for cruise propulsion).

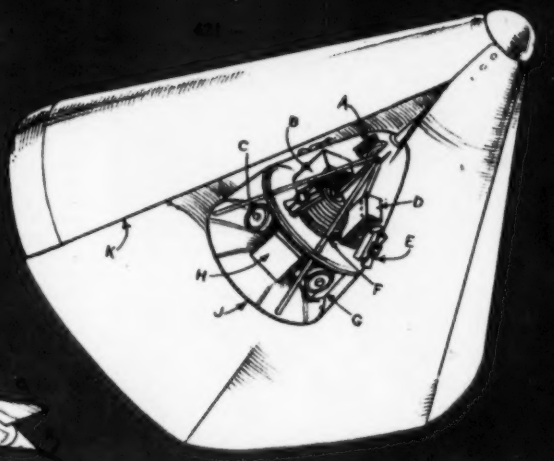
Missiles and Spaceflight

A communication satellite project A scale model on the Hawker Siddeley stand shows an active communications satellite which has been the subject of study by the Advanced Projects Group of Hawker Siddeley Aviation at Kingston-on-Thames. Launching would be by a Blue Streak modified Black Knight and an unspecified third stage, and the intended orbit is elliptical with apogee at 12,500 miles, perigee at 300 miles, and a 63° inclination. The satellite's radio receiver and transmitter would employ a 3ft diameter parabolic reflecting aerial and would provide 100 speech channels at 450mW per channel. Earth-seeking attitude stabilization would be by means of a flywheel system actuated by horizon sensers. Power (500W) would come from solar cells located on the four petal sections, and de-spin HTP reaction jets are included in the design. Estimated weight is 600 to 700lb.

Inboard profile of the Bristol Siddeley BS.75 turbofan







Avro Blue Steel Mk 1: A, rudder; B, elevons; C, foreplanes; D, folding fin; E, drooped tips; F, Bristol Siddeley Stentor engine; G, turbopump; H, blast-out seals; J, static point; K, pressure head; L, turbopump exhaust; M, "Danger HTP"; N, HTP overflow; P, HTP drain; R, HTP vent; S, HTP filling; T, condensate drain; U, "Danger high explosive"; V, drain. The wing tips droop; leading-edge sweep is constant

Hawker Siddeley communications satellite: A, flywheel; B, batteries; C, horizon sensors; D, attitude control; E, reaction jets; F, HTP tank; G, receivers; H, transmitters; J, parabolic reflector; K, solar cells

Strategic stand-off bomb For the first time, the Weapons Research Division of A. V. Roe & Co Ltd have been permitted to display a Blue Steel air-to-surface weapon. Mounted on trestles in the outdoor missile park, the great supersonic canard is representative of production Mk 1 weapons for RAF Bomber Command. Its exterior is finished in matt black, and an accompanying diagram indicates some of its more interesting features. Most of the body seems to be occupied by HTP (high-test peroxide) for the Bristol Siddeley Stentor engine, kerosine tankage being of much smaller volume. The two chambers of the engine are sealed by covers bearing the legend DO NOT REMOVE FOR FLIGHT—suggesting that the interior is pressurized by an inert gas, the covers being blown off as combustion pressure builds up when the engine is fired at altitude.

Seacat's guidance revealed This weapon for protecting ships against aircraft which pass unscathed through the outer defences of a fleet has in the past been described as having guidance "of a novel type"; this year the guidance can be seen to be of a radio-command type. The outdoor exhibit includes both major elements that make up a complete system; the quadruple launcher and the director. The latter, which may be mounted in any part of a destroyer (or other ship) with a clear field of view, is manned by a pair of ratings. The control officer stands up and rotates the director so that the aimer (the second rating), seated in a bin, can pick up targets visually and follow them through binoculars. When the target is within range the first missile is fired; and, since the control officer has turned the director to face the target, and the launcher is linked with it in azimuth, the departing missile rapidly comes into the field of vision of the aimer. The latter can thus drive the missile into coincidence with the target by moving a joystick to initiate demands to climb, dive, go left or go right, which are passed through the radio link to move the missile's four wings. The launcher, demonstrated by a naval crew, has this year sprouted an excrescence in the form of a thimble-shaped radome which doubtless contains a spiral aerial to pass the guidance demands. Capable of firing four rounds without reloading, it is produced by Rose Bros (Gainsborough) Ltd; the director is by Short & Harland.

Towards commercial hovercraft

A part-cutaway model on **the Westland** stand shows the type of commercial load which might be carried by the SR-N2. A 3-ton lorry, two Land-Rovers or 66 passengers are accommodated in the central 20ft by 16ft payload area between the fan intakes. Aft, four Blackburn Nimbus free-turbines are housed in pairs in an engine room, each pair driving a lift fan/propulsive propeller combination. Shafting for the forward units passes through the roof of the central cabin. Control is effected by varying the pitch of the propulsive propellers and swinging them laterally on their pylons through ±30°.

The basis of SR-N2 is a composite beam formed by an ogival-shaped buoyancy chamber, the deck above the air duct and the passenger cabin. The buoyancy chamber is divided into 15 watertight compartments with two transverse 425gal fuel tanks and two 100gal water tanks for fore and aft trimming. Full data now revealed are:

Length, 60ft 3in; beam, 29ft 6in; normal tankage, 850gal; typical operational weight, 29 tons; range, 200 n.m.; typical cruise speed, 70kt; cruise hoverheight, 1.0-1.5ft; maximum hoverheight, 2.5ft.

Westland say that SR-N2 is a development vehicle for a hovercraft of 70-125 tons—"the minimum commercially competitive size." Diameter and power requirements of fan and propellers are such that they could be used directly on a machine of between 70 and 300 tons. A 125-ton development could carry 26 cars and 200 passengers at an equivalent direct operating cost of 1¼d per passenger mile; with the SR-N2 it would be 4½d.

Accessories

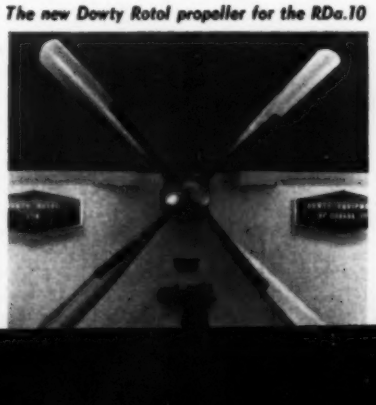
VTOL control and lift fans Engine bleed or jet-efflux-driven fans for the control of vertical take-off aircraft were a **Boulton Paul** innovation at the last SBAC show. This year, **Dowty** are showing a new unit which they are using to investigate the advantages for pitch and roll control of turbofans over variable-area nozzles or arrangements where direct-lift thrust of the main engines is varied to obtain control. Preliminary results are said to show a favourable thrust/weight ratio and reduced gas ducting size. A six-bladed fan is rotated by an impulse-type turbine running at about 25,000 r.p.m. which drives through step-down bevel gears at 11,000 r.p.m. Although turbine and fan are here mounted side by side, the turbine could be mounted on the fan hub or as a fan-tip arrangement. Thrust is varied by controlling fan pitch. Dowty are following up with tunnel tests on turbofans in model wing and fuselage sections.

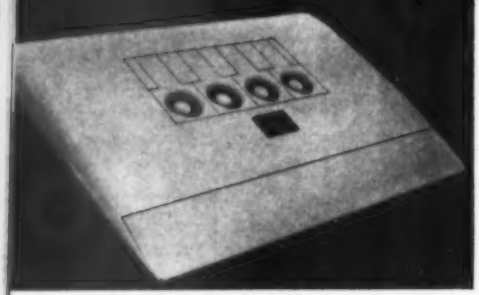
This is the stage now reached by Boulton Paul, who are showing multiple fans buried in a rectangular wing and a large delta-winged aircraft model with a central lifting fan. These models are representative of a number of studies made by Boulton Paul into the effects of multiple fans, interference with nacelles and the advantages of fans *vis-à-vis* ducted-fan lifting engines.

New propeller Propellers are not much in evidence this year but a brand-new one appears on the **Dowty/Rotol** stand, destined for the Japanese YS-11 transport. It is thus the first propeller to be shown which will be married to the Rolls-Royce Dart RDa.10/1 of 2,750 s.h.p. Fully reversible, it is of 14ft 6in diameter and has a low solidity factor.

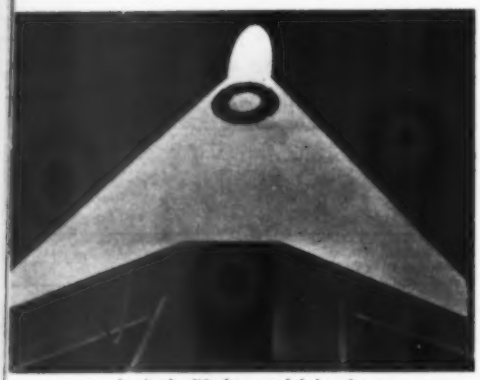
Model of the Westland SR-N2 (compare with page 351 last week)

The new Dowty Rotol propeller for the RDa.10



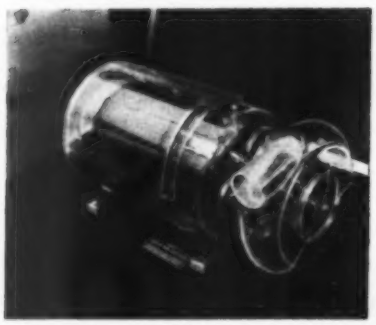


Boulton Paul multi-lift-fan tunnel-model wing



A single lift-fan model by the same manufacturer, on a delta wing

Dowty/Rotol VTOL control fan



Rotax constant-speed drive starter model

New corrugated PTFE pipe by Palmer

Side-folding nose gear A half-scale model of the nose undercarriage for the D.H.121 Trident is the centrepiece of the **Lockheed Precision Products** stand. The unfamiliar shape of the robust main forging results from the sideways retraction of this leg and it is apparent that drag and bending loads are reacted through the swivel pins which are formed integrally with it. All the steering parts are reproduced to scale and representation is made of the quick-release pin which frees the toggle links for towing purposes.

Constant-speed-drive starters In the minds of many engineers, two new CSDS are among the major highlights of the accessory manufacturer's display. The constant-speed-drive story is a fascinating one, and we shall return to it again in a subsequent issue. Both the **Plessey** design and that built by **Rotax** under licence from the AiResearch Division of the US Garrett Corporation have facilities for acting as a constant-speed drive, as an engine starter from an external (or internal APU) air source, and for ground checkout of the electrical system without running the engine.

The Rotax CSDS utilizes a turbine spun by bleed air to trim the output speed of the differential gearbox which transmits shaft power from the engine. In the cruising condition about 70 per cent of the power is transmitted mechanically, the remainder by the bleed-air turbine, the value being set at this level to provide a datum about which turbine r.p.m. can be varied. Varying amounts of bleed air are thus required throughout the flight regime, but against this the units display an excellent power/weight ratio and may be operated by cross-bleed from another engine should the main power source fail. The range of units covers 20 to 150kVA; frequency tolerance can be as little as ±0.1 per cent in the steady state or ±5 per cent transient with recovery in 1sec.

Plessey's CSDS makes use of a positive-displacement Roots blower-type air motor interconnected to the differential gearbox to add or subtract speed to hold output r.p.m. constant. The special feature of this design is that a null-point is reached where virtually no bleed air is required and where the air motor is stationary. From this speed upwards bleed is scarcely required as the air motor is operating in a negative direction. Constant-speed control throughout the range is achieved by an hydraulic governor and servo-actuated air valve. Both governor and air motor are substantially similar to other Plessey units, and the first CSDS was designed and built at the end of last year in just two months. The unit on show transmits up to 102 h.p.—sufficient, say, for a 40 or 50kVA machine.

Mathematical tour de force Shown for the first time is the "black box" of **Decca's** Omnitrac which encompasses the remarkable mathematical process for converting hyperbolic into rectangular co-ordinates. With Omnitrac are new Flight Log and roller-map presentations making use of this capability.

New HF data-link Now being groomed for airborne trials in a BOAC Britannia is a **Cossor** HF data-link system designed for use on the North Atlantic. The ground station shown in the Cossor enclosure will shortly be transferred to Ireland. Standard code signals will first be transmitted to check the required code redundancy and quality of transmission.

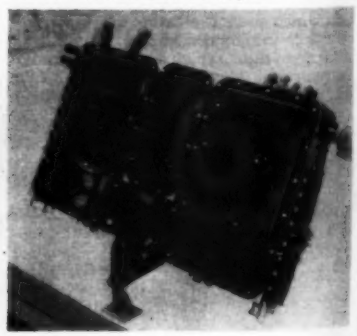
Multiple feel simulator There are few manufacturing monopolies within the accessory industry, but in the field of artificial control feel **H. M. Hobson** have never been challenged. Those accustomed to regarding this firm's hydraulic feel simulators as relatively small controls and jacks together weighing only a few pounds may well be surprised at the unit developed for the VC10 and shown on Hobson's stand in prototype form. Working on all three axes, and self-contained in all respects, it is a suitcase-sized package weighing 165lb. Within its scantlings are duplicated hydraulic reservoirs and electrically driven pumps, and controls and jacks for rudder, ailerons and elevators—six in all. Feel follows a V^2 law, but there is altitude correction on pitch and roll channels and gearing on the ailerons: at any speed stick force increases non-linearly with aileron angle.

New noise suppressor It was recently announced that **Flight Refuelling** are finalizing a licence agreement to manufacture Curtiss-Wright portable noise suppressors. These trolley mounted units can be used on any engine with up to 330lb/sec mass flow. There is an inlet section, mixing section and a 90° elbow deflecting the gas and residual noise vertically upwards. The inlet section houses a stainless-steel sound sieve which reduces blast velocity and induces mixing with the secondary flow. An internal resistance downstream further reduces jet velocity. Overall noise reductions of 30-35db are claimed and 1,500hr of maintenance-free operation is guaranteed.

New pipe materials PTFE is being used for the first time by **Palmer Aero Products** in corrugated form to provide a light and flexible conduit which can be incorporated in light-alloy electrical harness. It is said to be particularly suitable for extremes of environmental temperature.

Lockheed nose undercarriage for D.H. Trident

Hobson feel simulator for VC10



European Congress of Aviation Medicine

Mr Thorneycroft, Minister of Aviation, leaves the inaugural ceremony in company with Dr Buchanan Barbour, BEA's director of medical services (left)

IF there are still people about whose sole idea of aviation medicine is the prudent carrying of a packet of Kwells, they should have been at the Royal College of Surgeons in London last week. In the College's elegant Edward Lumley Hall was held the fifth European Congress of Aviation Medicine, attended by over 400 specialists from 29 countries. The Congress was sponsored by BEA, BOAC and the three armed Services, and organized by a committee under the chairmanship of Dr A. Buchanan Barbour, BEA's director of medical services.

Officially, the congress convened to discuss the human problems attendant on commercial flying at supersonic and hypersonic speeds, but in more than 60 papers presented in four days of working sessions, many "fringe" subjects were covered, too, including immediate medical problems and researches of direct military or astronautical value.

The organizers wisely arranged for each session to be opened with a paper by a technical or operational pundit, defining problems in general terms, followed by a complementary main paper from a medical specialist. Numerous short and specialized papers, generally relevant to the session heading, then followed.

The first session, under the general title *Flying Personnel Research*, was opened by Sir Frederick Bartlett, Emeritus Professor of Experimental Psychology at Cambridge, who spoke on the future outlook for this subject. It was about 1910 that the first phase in selection techniques began, he said, when special tests were formulated to determine specific human abilities. This pattern lasted until about 1940 when the second phase began, and emphasis was placed upon the subject's adaptation to instruments and technical aids.

New Methods

"The third chapter is now beginning to be written," said Sir Frederick, "and the next few years will bring new methods in finding and training flying personnel. Future personnel will require more general abilities than those in the past, for the emphasis is less on specific abilities for specific tasks. As speeds, altitudes and instrumentation increase, and automatic aids both in the air and on the ground assume more of the actual controlling functions, the required human qualities are now less specialized. Of the future flight operator, quickness, alertness, speed of decision, endurance and a willingness to welcome and adapt himself to strange conditions of behaviour are required. He will be reliable rather than meticulously accurate, and his qualities will be very hard to spot."

Within limits, medical standards could be reduced, for vision and hearing would be less important. The first essential, a well-balanced human nervous system which would retain a high degree of efficiency in strange new conditions, would be difficult to characterize, to identify and to understand.

The speed and direction of current developments cried urgently for greater discussion and research on the mechanism of the central nervous control. There must be more positive qualities (such as endurance) of which their possessors were proud, and less on negative values, such as fatigue, which was "a graveyard of theories surrounded in disrepute."

We have reported Sir Frederick Bartlett's paper at some length because it seemed in retrospect the kernel around which those papers directly relevant to future commercial air transport clustered. The role and environments of future aircrews, and selection techniques in the physical and psychological spheres, were the concern of many subsequent speakers.

Mr C. S. R. Marshall, chief systems engineer of the Hawker Siddeley advanced project group, spoke at the second session on the problems involving human factors in the design and operation of supersonic transport. He said that the human factors required extensive study in the design period, and doctors must be brought in at the initial project stage. The crew's primary role in the highly automatized aircraft of the future would be to monitor equipment and diagnose system faults in the air, thereby saving ground time.

The crew would have certain manual functions to perform in the event of system failures. The design of semi-automatic systems would be aided by the formal description of the operating characteristics of the human being so that his effect in the servo loop could be calculated and allowed for before the final test stage.

Mr Marshall was the first of several speakers who were concerned with the passengers' environment in supersonic aircraft. He believed that the cabins would be windowless, and passengers' psychology must be studied because of the claustrophobic environment, and to ensure calm behaviour in cases of emergency. Their tolerance of manœuvres must be increased, for passengers disliked high g forces. Failure to increase passenger tolerance would mean that flight evolutions would have to be so gentle that a Mach 2 aircraft would fly 50 n.m. along its track to correct a heading inaccuracy of 20°, if only a 20° bank were acceptable.

Mr Marshall concluded with a list of subjects demanding early attention from the human engineers: operating and instrument systems; functions of individual crew members when relieved of responsibility for the primary controlling functions; diet and environments; maximum acceptable manœuvres; passenger psychology; minimum levels of comfort; action in emergencies; and economics of the human engineering.

In a complementary paper, Air Cdre W. K. Stewart, Officer Commanding the RAF Institute of Aviation Medicine, detailed some biological aspects of supersonic flight. New criteria would be introduced in flight deck presentation and in warning methods, which would involve bi-sensory signals of sight and hearing. As far as crews were concerned, one biological effect of the shuttling at high speed between different climates and time zones would be urinary variations, when the kidneys "got out of gear."

Passengers might ride in the supine position, particularly in the climbing phase, when accelerations would be high and the floor angle steep, but nothing was known about the effect of linear accelerations on people in this position who had no reference to the outside world—for Air Cdre Stewart, too, believed that supersonic transport aircraft would have no passenger windows.

Nothing was known about the inter-action between subjects in the various conditions of supersonic flight, for in supersonics all knowledge defined as experience was confined to military aircraft with crew compositions of one and never more than three. Both psychological and physiological problems would be raised in the social sphere.

Despite all these factors, Air Cdre Stewart was confident that with close attention to passenger comfort and psychology, supersonic airline travel would be both "pleasant and desirable."

Element of Prediction

As the man responsible for the flight procedures evolved for the world's first commercial jet aircraft, and now a director of Smiths' Aircraft Instruments, Captain A. M. A. Majendie was well qualified to speak on the relationship of pilots and monitors, human and automatic.

Capt Majendie stressed that automatic systems were "human" in the sense that they reflected the capabilities and shortcomings of the humans who create them. Thus, the human element was in no way removed; automatics merely deployed human effort in different ways, and at different points in time and space. The separation of human effort and application to the task made a great concentration of effort possible on individual needs, but it introduced an element of prediction in design which was the limiting factor on the capabilities of auto-systems.

Automatics were entering a new era, for only in the future would they be performing ultra-human tasks—automatic systems in current subsonic aircraft merely relieved the load on the pilot; and in the event of failure the pilot could take over and perform their task. In the event of the malfunction of ultra-human automatics (e.g., automatic blind landing systems) no reliance could be placed on the human pilot to take over, for if we insisted on human manual control in emergency we tied ourselves to human capabilities at any one time, and restricted aircraft capability accordingly.

Capt Majendie spoke of the form that pilots' monitoring displays would take, and showed graphs of pilots' performances obtained when a "pursuit" display of pitch information was set up on a simulator and compared with results obtained with a lesser "compensatory" display. Better results were obtained with the compensatory means, suggesting that the more sophisticated pursuit display was not necessarily the best, inducing self-satisfaction and over-confidence in the subjects tested. The compensatory concept was employed in Smiths' new Para-Visual Director.

A longer report of some of the many papers in which specific problems and specific researches were described will appear in a forthcoming issue.

R. R. R.

Straight and Level

ONE of the things I like best about the Farnborough Show is the drive down there, when it's not raining. There is a special enchantment about an early September morning, the misty expanses of Windsor Great Park, the beeches along the Bagshot road just beginning to yellow, and the swoosh of an overtaking Bentley with the PRESIDENT'S ENCLOSURE sticker on the windscreen and very top-looking people immured in the back.

And, when you get there, there is the whiff of Avtur coming off the airfield, the pageant of fifty of Britain's best aeroplanes—including the Dove. It's been at the SBAC Display every year since 1946. Good gracious, one says, the Dove's here again! This *must* be positively its last appearance, even in the static park. One has been saying it for years; but it defiantly continues to sell, contemptuous of this fast-changing aeronautical world in which aeroplanes are old almost before they are new.

This year, I see, the Dove has reappeared, in Mk 8 form, in the flying display—listed one ahead of the Argosy.

● de Havilland sponsored another symbol of continuity with the past on Thursday evening of last week. At Hatfield was perhaps the most distinguished gathering of old-timers ever reunited on D.H. soil: Sir Geoffrey de Havilland, the fiftieth anniversary of whose first flight falls tomorrow, September 10; F. T. Hearle, D.H.'s first colleague; and C. C. Walker, W. E. Nixon, Hubert Broad, Sir Alan Cobham, A. E. Hagg, and many others. There is a photograph on page 403.

The object of their reunion was G-EBHX, the diminutive D.H.53 Humming Bird of 1923, beautifully restored for the Shuttleworth Trust by the D.H. Tech. School. Unearthed five years ago in a Kent back garden by L. A. Jackson of the Shuttleworth Trust, it was flown by Sea Vixen test pilot Chris Capper (like the Humming Bird, aged 37) in company with de Havilland's 1925 D.H.60 Cirrus Moth G-EBLV, C. A. Pike up.

These two blue and silver veterans pop-popped (D.H.53) and purred (D.H.60) in formation over the firm whose bread and butter they once represented. One banking turn took them over the Blue Streak static test towers and the neighbouring D.H.121 structural test tank—representing the firm's future bread and butter which, for this nostalgic moment, it could be allowed to forget about.

● Here is an interesting piece of arithmetic. Last year air mail traffic carried by Qantas went down four per cent. At the same time air mail revenue earned by them went *up* by more than eight per cent. Obviously, it would seem, the price paid to them for each bag of mail was considerably increased.

But according to Qantas, the mail rate went down—by quite an appreciable amount. In other words, the Australian airline received a lot of money for traffic that it didn't carry (I estimate the figure to be more than £1 million).

We can only suspect that the money came from BOAC, under the terms of their pool agreement with Qantas. There is no other possible explanation. Now a million quid is a lot of money to get for traffic you don't carry. It is, in fact, Qantas's profit for 1959 (see page 405).

It could be that this apparent subsidy of profit-making Qantas by our debt-ridden BOAC is justified. And it could be that this particular pool agreement, and the couple of dozen others operated by BOAC and BEA are of unimpeachable propriety and in the national and public interest. It could be right, too, for BEA to finance Comets for a foreign shipping millionaire; for BOAC to acquiesce to Indian and Australian demands to keep Britain's independent airlines off scheduled eastern hemisphere routes; for British airlines on British routes to be planning to fix prices and output and to share earnings without having to bother about the Restrictive Trade Practices Act.

* * *

All this, as I say, could be right. But it doesn't *seem* right, does it? Is it not time that Parliament and the public were allowed to know more about the terms of these secret pools? You may ask: "But surely the Minister keeps an eye on all this, doesn't he?"

The other day a *Flight* colleague asked a Very Senior Executive of one of our two air corporations: "Does the Minister require you to file with him the terms of your pool agreements?"

For what seemed like a whole minute the Very Senior Executive contemplated the carpet. Finally he said, with a grin, "What does the Minister say about this one?" So when we discovered Qantas' missing million, we thought it was time to ask the Ministry this very question.

The answer: "No, we do not require the airlines to file with us the terms of pool agreements. They are a matter for the commercial judgment of the airlines."

● Each year *Flight* does a Who's-who of SBAC show pilots (see pages 435-437), and sometimes familiar names disappear. There was a somewhat wistful note about this reply to our questionnaire from Ranald Porteous of Auster: "Alas, much as I would be honoured to have my biography appearing again among those of the Farnborough pilots, we are not allowed to fly in this year's display as all our modern range of aircraft use American engines and propellers. Needless to say, we are very sad about this . . ."

Needless to say, everybody else is too. This year we were going to photograph not the Auster being aerobatted by Porteous, but the faces of the crowd watching his famous "avalanches."

I transcribe with scrupulous fidelity the official caption to this picture of the French Armagnac: "The centre piece of the 1953 Air Show in 1953 in Paris was the four engined French Armagne. But it has not achieved the success anticipated. Six shinning new models which have been awaiting purchasers since 1958 or Orly, in vain, will go to the scrap heap . . . Picture shows:—The Armagnac at the 1953 Air Show . . . . ." I just can't bear to think of it. Six shinning Franch Armagnac heading for the scrap hope. And not a scrop of hape for them

Space for Garage

● "The Echo L satellite balloon is giving trouble to the Harris family in Oklahoma City. Mr Harris has a radio-controlled garage door which opens and closes at the push of a button in his car. On at least three nights recently the door rose and slammed down again at the exact moment the balloon satellite was passing overhead.

"An engineer says it is possible for the door's mechanism to be triggered by low frequency radio signals bouncing off Echo L."—*British United Press report.*

ROGER BACON

Looking-in on the Industry

TEXT BY HUMPHREY WYNN
DRAWINGS BY GORDON HORNER

IMPRESSIONS OF AIRCRAFT AND ENGINE PRODUCTION IN 1960

THROUGH the office windows I could see huge dockside cranes, ships in building, the proud prow of the recently launched *Canberra*, and beyond the shipyard the green slope of Cave Hill, which rises to the west of the wide waters of Belfast Lough. A strangely sea-girt scene, perhaps, with which to introduce an impressionistic view of some centres of the British aircraft industry in the late summer of 1960. But chance had brought me first to the Belfast headquarters of Short Brothers & Harland Ltd; and this historic firm, with its fine tradition of flying-boat construction, fits naturally into a seaside environment and makes an apt neighbour for Harland & Wolff on Queen's Island. But flying-boats no longer go down the slipway into the lough: Short Brothers have moved with the times and are building missiles, target and reconnaissance Canberras, and Britannias for RAF Transport Command. Soon they will start building Britannics and their own Skyvan light transport; and they have successfully entered the VTOL field with the SC.1.

THIS is not a technical dissertation; neither is it a comprehensive description of the British aircraft industry. It is simply a series of impressions which, it is hoped, will appeal equally within and outside the industry, based on visits to certain firms. In half-a-dozen cases the visits are recorded by drawings; in the rest verbally. Photographs have also been used to supplement the descriptions. The aim has been to give a picture of what is going on at some of the industry's main centres in mid-1960, on a kind of magic-carpet tour, achieved mainly through the agile agency of "Flight's" Miles Gemini. Emphasis has been laid on the location and physical appearance of company premises visited, normally a closed book both to the general public (who, after all, pay for much of what is going on) and also to members of other companies. "Flight" wishes to record its gratitude for the facilities and hospitality afforded to its representatives on their travels.

What pattern does this show for the British aircraft industry after its first 50 years? It is worth keeping in mind the general position before looking at Queen's Island in more detail, at the start of a sort of dual Gulliver's Travels, recorded by the writer's pen and Gordon Horner's pencil.

The industry at which we have been looking is in one sense less complex than it was a year ago: mergers which came about this springtime have reduced the number of operational units and clearly defined the centres of control. The two giants in the airframe and missile manufacturing world are the Hawker Siddeley Group and the British Aircraft Corporation; the largest engine

Above, Handley Page Heralds at Woodley: the demonstrator (left) being checked after a sales tour, with a production aircraft alongside. At left, what the artist didn't see at Brough: NA.39 production

Looking-in on the Industry . . .

enterprises are Rolls-Royce and Bristol Siddeley; and in helicopters all developments are directed by Westland.

Though there has been a great deal of streamlining in 1960, however, it has not embraced the whole of the industry. Several aircraft manufacturing firms, like Handley Page and Scottish Aviation and Auster, are as yet outside the big groups; there are some independent engine manufacturers, like Alvis; there are concerns with specialist tasks, like Hovercraft Development Ltd and Martin-Baker and Flight Refuelling; and there are hundreds of ancillary companies, manufacturers of anything from radar equipment to aircraft galleys and from lifejackets to split-pins, who contribute their independent design and constructional skill to the industry's end-products.

Naturally a quick view such as this can only be based on selected impressions, though from them a picture of the whole may emerge. The general trends are clear—missiles for both military and scientific application; bigger and faster airliners; STOL developments; helicopters for commercial use and wider Service employment; transport aircraft to move the Strategic Reserve and to replace the ubiquitous DC-3; and hovercraft to operate on commercial routes. More powerful engines; and advances in ancillary equipment to give corresponding assurances of safety at ever-increasing speeds and higher operational altitudes.

The chance that led me to make my first visit to Short Brothers was a happy one, for this great firm on Queen's Island (not really an island, but land reclaimed from Belfast Lough) is the senior company in the British aircraft industry. With justifiable pride, Short Bros proclaim themselves "the first manufacturers of aircraft in the world." It all began in 1901, when Oswald and Eustace Short were appointed official balloon makers to the Aero Club, with workshops under the arches of a Battersea railway station. Shorts seem to have had a penchant for islands, for they transferred their site to the Isle of Sheppey about 1909; and they have also been traditionally associated with seaplanes and flying-boats, notably the family of floatplanes famed in the First World War and the great line of Sunderlands, which appeared in 1937 and have only recently gone into retirement.

Since moving finally to Belfast in 1948, the company have produced designs of uncommon interest and variety: the SB.3, SA.4 Sperrin (the first jet-powered heavy bomber in this country to complete its trials) and SB.5; they have applied their manufacturing skill to the production of Canberras, Comets and Britannias, and the modification of Canberras as drone target aircraft; and have successfully entered the missile field with Seacat, and its associated land vehicle Tigercat, with allied computer techniques.

Walking round the vast production hangar at Queen's Island, I saw PR.9 and U.10 Canberras and the last of the Britannias for Transport Command, and the great jigs of tubular scaffolding on which the Britannics are to be built—the aircraft on which the future prospects of Short Bros largely depend. The size of the jigs was impressive; it looked as if the company was building ships, not aeroplanes. But perhaps this was not inappropriate: cheek by jowl with Harland & Wolff, Short Bros represent with the shipbuilders the twin pillars of major industry in Northern Ireland; more than any other unit of the British aircraft industry, their future has political as well as economic significance.

Through the difficult times which they have been experiencing, Short Brothers' penchant for unusual designs has not deserted them. The latest is the first project of their light aircraft division, formed in April last year: a light freighter, the SC.7 Skyvan (described in *Flight* for August 26), being developed as a private venture. This is to carry a payload of 1½ tons and is designed to operate from any 880yd airstrip. Something new out of Belfast? Private ventures are always commendable and Shorts deserve success; whether they can command it, in this harsh competitive post-Korean War world, is an apocalyptic question.

* * *

After Northern Ireland, I went to visit the helicopter country, concentrated in the West of England with headquarters at Yeovil in Somerset. From there, since the mergers which took place earlier this year, Westland Aircraft control production at three centres: Eastleigh (Saunders-Roe), White Waltham (Fairey) and Weston-super-Mare (Bristol). Westland's works, on the western edge of the Somerset market town, have an almost rural charm: trim flower beds and evergreen bushes soften the sharp outlines of hangars; the grass airfield conveys something of a pre-war atmosphere; and Widgeon, Whirlwind, Wessex and Westminster have an alliteration which spells local prosperity.

The company's future, however, is of considerably more than local concern: Westland's recent acquisitions have made them the largest helicopter manufacturing group in Europe. They are especially proud that at Farnborough this week they are fielding the world's largest team of assorted helicopters. In ascending order of weight these comprise the 2,200lb Skeeter two-seater; the 5,000lb Wasp and Sprite, seating five or more; the 5,900lb Widgeon, typically a five-seater; the Whirlwind, weighing around 8,000lb and seating eight or ten; the Wessex 1, in the 13,000lb class and at present equipped for anti-submarine work, though also available as a twelve-passenger transport; the twin-rotor Belvedere, grossing up to 20,000lb, and in one of its configurations carrying 18 to 25 troops; the heavy-lift Westminster at 36,000lb; and the Rotodyne VTO airliner, which in its production form will have 57 seats in a typical layout and will tip the scales at 53,500lb.

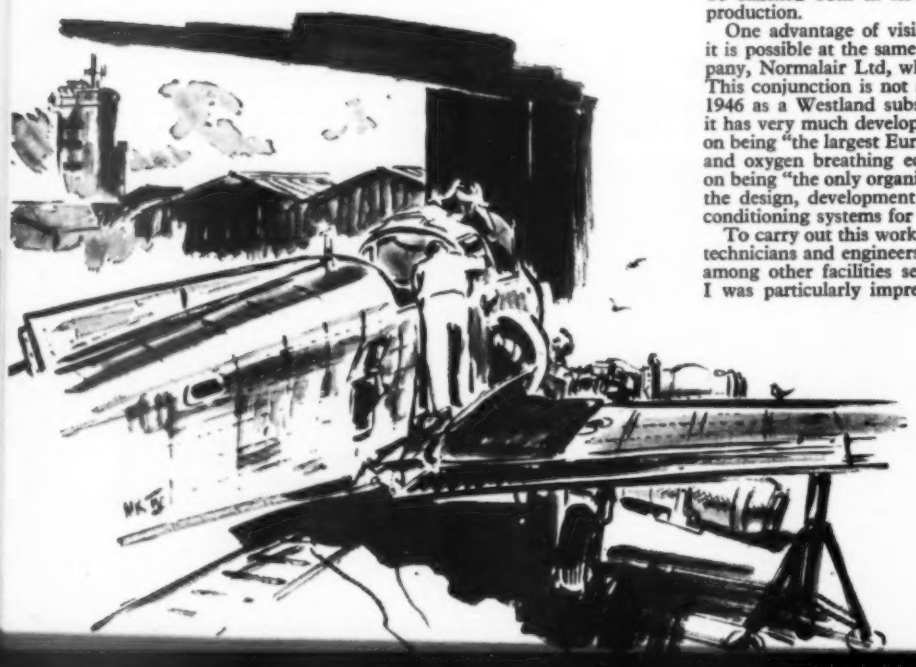
At Yeovil I saw Wessexes, Whirlwinds and Widgeons under construction or undergoing conversion for special requirements. The first-named is still being proved by the Royal Navy, which has in it its first helicopter combining both a search and strike anti-submarine capability.

The Navy is still the largest customer for Westland helicopters, and their use of them is a source of encouragement to the Saunders-Roe division at Eastleigh, where the highly successful P.531 (called Wasp or Sprite, according to application) was created: three of these nimble machines have recently completed 200 hours' Naval flying without unserviceability; two of them have been back to Eastleigh for servicing, where they are regarded with justifiable pride. The Army are likewise Saunders-Roe customers, both for the P.531 and the tiny Skeeters, about eight more of which are to be built at Eastleigh.

Saunders-Roe are proud of their helicopter achievements, proud, too, of the work they have carried out under contract for other companies—760 sets of Vampire wings for de Havilland, 420 sets of Viscount wings for Vickers, a number of Thunderbird details for English Electric. They have built up a good design and production team at Eastleigh and want it to continue; there is some misgiving at present that P.531 production might be transferred to Hayes as part of Westland policy. But no such decision has been taken; the future shape of Westland progress has yet to be clarified both in its wider terms, and as to distribution of production.

One advantage of visiting Westland Aircraft at Yeovil is that it is possible at the same time to see an important ancillary company, Normalair Ltd, whose premises adjoin those of Westland. This conjunction is not accidental, for Normalair was formed in 1946 as a Westland subsidiary; though in the intervening years it has very much developed a life of its own. It now prides itself on being "the largest European producer of cabin air-conditioning and oxygen breathing equipment for aircraft," and additionally on being "the only organization in Great Britain able to undertake the design, development and production of complete cabin air-conditioning systems for all classes of military and civil aircraft."

To carry out this work, Normalair have over a thousand skilled technicians and engineers, and their laboratory at Yeovil includes among other facilities several large high-altitude test chambers. I was particularly impressed by their large new high-altitude/



Hunting Jet Provost assembly at Luton, with Bristol Siddeley Viper engine in the background. Note the birds—a perennial nuisance in hangars

high-temperature decompression chamber, a vast structure in which whole sections of aircraft fuselages or guided missiles can be tested under conditions likely to be found at heights of up to 19 miles and at Mach 3 speeds. There are two large power houses to serve these facilities, making a total of 4,000 h.p. available to drive exhauster pumps and air compressors. At the other end of the size scale, there is a small chamber for the high altitude testing of personal oxygen equipment. Normalair also pride themselves on their precision manufacturing of delicate equipment, and their newest premises are air-conditioned for the assembly of equipment under conditions of extreme cleanliness, all components being kept in protective wrappings until required for assembly.

It is interesting to reflect that the important work which this company is now doing derived originally from the cabin pressure control equipment devised by Westland Aircraft in 1940 for the first British pressurized aircraft to go into production, the high-altitude Westland-Welkin twin-engined fighter.

* * *

From Westlands I went to Weybridge, that famous centre (as Brooklands) in the history of British motor-racing and aeroplane achievements, and in a hangar there saw another kind of future shape—the wooden mock-up of the VC10, that beautiful realization of clean-wing and rearward-sited-powerplant design. This is the Vickers-Armstrongs (Aircraft) conception of a transport aeroplane of the future—a near future, because the VC10 is due to make its first flight next year; and seeing the mock-up was one of the most exciting impressions I gained in a visit to the company's headquarters. The rich experiences gained in the Viscount, Valiant and Vanguard has been synthesized and distilled in the VC10.

It is not only the steeply banked corner of the racing track which is still visible which gives one a sense of historical perspec-

D.H. Comet 4B production line at Hatfield. (Below) Martin-Baker mobile ejection-seat test-rig being demonstrated at Upper Denham: maximum velocity, 40ft/sec. A static rig is in the background

Looking-in on the Industry . . .

tive at Weybridge. On the west side of the airfield there is a small red-roofed building, which in the old days was a booking-office for flights from Brooklands: it stands there now empty and anonymous, but has looked out since the war on the first flights of those successful Vickers aircraft the Valiant and the Viscount. But Weybridge airfield has now proved too small for modern requirements, and test-flying is done from Wisley: the new aircraft are flown over there at minimum weight; at Wisley there is ample runway accommodation and some of the best radar facilities at any manufacturer's airfield are available for the guidance and recovery of aircraft on test flights.

Weybridge presents a picture of three current activities: completion of Viscount orders; production of Vanguards for BEA and TCA; and the start of VC10 production, with immense jigs being built to take the first aircraft. Here one can see the Vanguard under construction from start to finish: the assemblage of the "double bubble" fuselage, its upper part for passengers and lower part for freight; close examination of the structure showed how strongly this aircraft is constructed. Inside the empty fuselage, bare of power and control lines and sound-proofing and furnishing, one gets a dramatic impression of the length of the machine and the size of its freight holds.

Wisley airfield lies just outside the London Control Zone. Its entrance is only a few yards from the A3 London - Portsmouth road. But nothing betrays the presence of an aerodrome to the passing motorist save a warning sign: "Sudden Aircraft Noise."

There was a mixed collection of aircraft in the hangars and on the tarmac: Vanguards variously in Vickers' own colours, and in BEA and TCA markings; a Valiant; some Scimitars. A Vanguard was having its engines test-run on the edge of the airfield; another had been undergoing stress tests in a hangar: the starboard wing allowed a 9ft strain before a crack appeared, testifying to the strength of construction.

Above: Steps to the future: the D.H.121 mock-up at Hatfield

A 1960 summer's day at Holme-on-Spalding Moor, the Blackburn Aircraft test airfield: preparing an NA.39 for ground-running

Vickers are confident in the qualities of the Vanguard as a load-carrier; they are disappointed at the delay enforced by compressor trouble with the Tyne engine, which will probably mean that the new airliner will not enter service before 1961—and until it is seen operationally, it is not likely to begin attracting further customers.

There seems to be, in all other respects, an air of confidence about the future at Weybridge—both for the company individually and as part of the British Aircraft Corporation. Tangible results of this amalgamation, however, are not likely to be seen for some time yet. One form of co-operation, the TSR.2, dated from before the formation of the BAC: the Corporation can now back it with unrivalled resources in design skill, experience of very high speed aircraft, and computer techniques.

* * *

It was perhaps appropriate that the next point of call, after Weybridge, should have been the English Electric test and development airfield at Warton in Lancashire.

I mention the county particularly, because all English Electric's aircraft (as distinct from guided weapon) activities are concentrated there, with factories at Preston and Accrington and airfields at Warton and Samlesbury (aircraft electrics come from Yorkshire, at Bradford). To visit Warton, which lies between Preston and St Annes on the north bank of the River Ribble, is to feel oneself on the fringe of new experiences in aviation. Not only is it the spiritual home of the Lightning, the fastest fighter aircraft that Britain has ever produced, but it is clearly geared to even swifter horizons: the Mach 1.7 wind tunnel is almost becoming an anachronism there, beside those being prepared for speeds of Mach 2 and Mach 6.

The scenery at Warton, apart from Winter Hill to the east and Blackpool Tower to the west, is dominated by Lightnings—that pugnacious-looking aircraft, with its great fin and seemingly downward-pointing appearance: Lightnings on development work, Lightnings on production test before going to the RAF, Lightnings back from RAF Coltishall bearing the badge of the Air-fighting Development Squadron.

Test-flying these aircraft, with their great speed and high altitude operations, raises special problems of ground control and recovery; and Air Traffic Control at Warton possesses some of the most capable equipment for the purpose.

Its radar range covers the UK (with allied controls in Northern Ireland and on the north-east coast)

(Right) Fuselage assembly of the Armstrong Whitworth AW.660 at Baginton, showing jigging for the crocodile-jaw tail

(Below) Building for the future: SC.5 jig at Short Brothers & Harland, Queen's Island, Belfast. These jigs are among the largest ever erected in Britain

Looking-in on the Industry . . .

from western England up into Scotland; and the equipment is deployed by a highly skilled team of ATC officers, who form a close link with the pilots in the work of English Electric test-flying: meeting regularly over lunch in the pilots' mess is a useful way of getting to know the man you are controlling, or who is controlling you. Spot-on co-operation is essential with aircraft travelling at Mach 2, when if avoiding action is to be taken a pilot needs to be warned when 20 miles away from an approaching aircraft.

The control tower at Warton built and equipped by English Electric stands in the middle of a now-disused runway, and its upper storey has double windows, which enables conversation to be carried on in reasonable tones even when a Lightning is taking off.

A word of praise to the Warton controllers from *Flight* would not be amiss, for their VHF assistance when the Gemini has visited the English Electric airfield or nearby Squires Gate, the Blackpool airport. On the last occasion the aircraft was watched on radar as far south as Hawarden, at a cruising level of 2,500ft: for operational purposes, however, the sets are geared to high-level coverage at the expense of low-level which is less required.

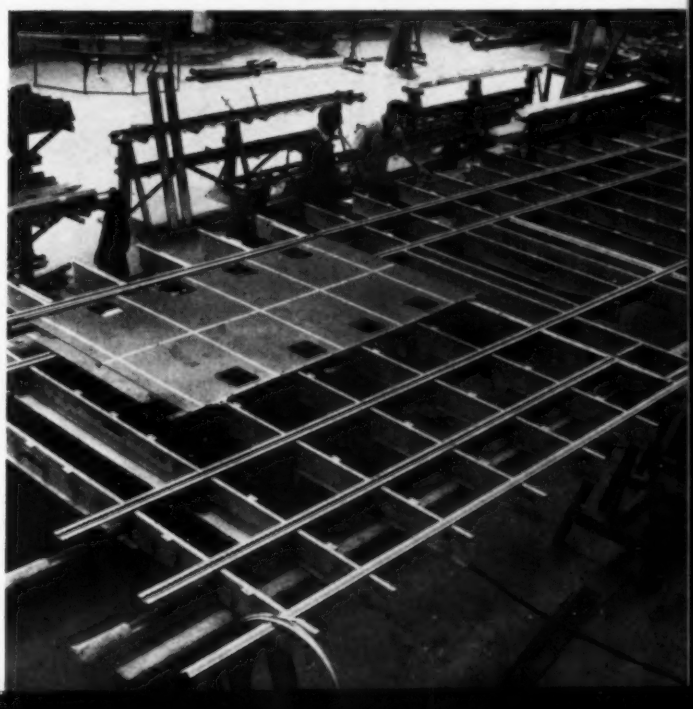
* * *

One advantage of visiting centres of the aircraft industry by air is that one can see, so to speak, the whole situation at a glance. Thus I saw Warton's position, on low-lying ground by the River Ribble (they sometimes talk of ships going into Preston, moving parallel with the main runway, as "on finals") and close to the Irish Sea; and when I flew to Staverton to visit the Dowty Group I saw Arle Court and its adjoining factories in their pleasant green location between Cheltenham and Gloucester, amid the Cotswold Hills.

The impression one gets on approaching Arle Court is aristocratic: this handsome house with its well-tended gardens dates from the Gothic Revival era, but its history goes back to the 13th century.

Clearly, one feels, here is a company with a feeling for its country surroundings; and Dowty have consistently tried to blend industry with Cotswold countryside. But they are far from being rural in their outlook, and the graciousness of Arle Court should not lead to any under-estimation of the commercial brains which operate there. Within the last year, Dowty have extended their production facilities by the acquisition of Rotol (whose premises lay conveniently next door) and British Messier, based on Staverton airfield. Behind Arle Court lies the headquarters of Dowty Fuel Systems, which has contributed the fuel system to the Bristol

Laying a foundation for the future: a VC10 floor being constructed at the Hurn factory of Vickers-Armstrongs (Aircraft) Ltd



Looking-in on the Industry . . .

Siddeley BS.53, and whose factory area is in process of being doubled in size.

How much the Dowty Group are contributing to current projects in the British aircraft industry is clear from some of the products they are exhibiting at the Farnborough show: gearbox for the Vanguard, ram air turbine for the VC10, main undercarriage legs for the Argosy and the Avro 748, fuel system for the D.H. Gyron Junior. A remarkable demonstration has been prepared (of which I had the privilege of a preview at Cheltenham) showing the properties of the Dowty Moog valve, by transmitting a tape recording through it—audible evidence of how power can be transmitted from electrical circuits to hydraulic controls, as on missiles or high-speed aircraft, where precise control is required at high power.

Dowty have long been famous for their undercarriages: their earliest successes were with the Gloster Gauntlet and Bristol Bulldog. At Arle Court is the largest undercarriage test rig in Britain, built for the undercarriage of the Bristol Brabazon: it is now used for testing the eight-wheel bogies of the Avro Vulcan, which are designed and built by Dowty.

Integrations are in fashion now, and Dowty were well to the fore in linking Rotol and British Messier to their future fortunes: this is a coupling of design skill to productive capacity, mixed with a dash of diversification (the Dowty Group's products range from propellers and servo units to nucleonics and the construction of lightweight power boats, pit-props, turbine-powered speedboats and railway buffers).

I found a similar sort of diversification when I went up to see Sir W. G. Armstrong Whitworth Aircraft Ltd, though their products are mostly related to aircraft and missiles. Flying into Coventry Airport at Baginton, you can see the company's main premises in the south-east corner of the airfield. A few miles away, to the north, is Whitley, AWA's former location. Here the famous Ensign airliner and the Whitley bombers were produced, and now Seaslug missiles are being made (designed in co-operation with GEC and Sperry): one gets a perspective of aeronautical history there, especially as one of the oldest wind tunnels in Britain (built in 1926) stands cheek-by-jowl with an intermittent and a high-speed tunnel.

As with many other manufacturers, AWA's aircraft have outgrown their airfield: test flying used to be done at Baginton, but a few years ago the company decided to transfer their test-flying activities to Bitteswell, a three-runway airfield to the east of the A5 road, and acquired it from the Air Ministry. Here all flight-testing is done on the Argosies, which are assembled in the Bitteswell hangars after being transported by road from Baginton. I was able to see the development prototype of the AW.660 military Argosy, with its rear-loading doors (variously described as "beaver tail" or "crocodile jaw") and side exits for parachute troops. AWA are proud of the Argosy, and have every reason to be so.

They also point with justifiable pride to their engineering skill and capacity at Baginton, where they build not only for themselves but for other companies in the Hawker Siddeley Group and outside it: I saw parts of the Vulcan and the Avro 748, Javelin drop-tanks and equipment for the UK Atomic Energy Authority. AWA are especially proud of their workmanship in the medium engineering field, particularly as applied to nuclear power, for example the precisely machined finned fuel cans which I saw at Baginton.

What might be described as an eerie sight at AWA is that of an Argosy being tank-tested to destruction. You can climb up and look down on this aircraft immersed in its tank; looking down into the water, you almost expect to see fishes or frogmen swimming around. As a counterpoint to this silent submersion, the wings creak pitifully as they are raised and lowered to find the ultimate stress, while the loads applied are measured and calculated. Here is the silent side of aircraft industry research, those gentle mathematics whose sums make for passenger safety. Similar searching tests, in an environmental chamber, are carried out on the Seaslug missiles produced by Armstrong Whitworth, to prove their efficiency to fly accurately to heights of 70,000ft.

* * *

From Coventry to Bristol is a logical step, for the famous engine firms which originated at these cities are now linked as Bristol Siddeley: and at Patchway, the factory on the north-east side of Filton airfield, I saw production work on engines which are powering Britain's current and future aircraft, from the casting of stator blades out of Nimonic alloys to the finished powerplant being ground-run and packed for despatch.

I found the process by which the blades are made quite fascinating to watch: first, an impression in green wax, much as a dentist might make for false teeth; then a forme in cement (looking quite surrealist, almost like shapes in Henry Moore's studio), from which the wax is melted away; then the foundry, where molten alloy is poured into the required shape, and where the foundrymen who work in such tremendous temperatures are given an hour off to cool down after their shift.

There is much visual excitement, too, in watching the test-run of a Thor ramjet with its efflux being drawn off, the condensation

forming a billowing white cloud of steam through a steel chimney (not an entirely popular operation with Patchway housewives on washing-day). Vivid purple flames can be seen through the circular observation panel. Again, the Olympus with reheat is a tremendous sight on its ground run in the development engine test-house, the long plume of its efflux forming diamond-pattern shock-waves.

Bristol Siddeley are in the unique position of contributing to projects by both big groups in the aircraft industry: with the advanced Olympus to the TSR.2, sponsored by the British Aircraft Corporation; and with the BS.53 lift/thrust ducted fan engine to the P.1127 vertical take-off fighter being built by Hawker Aircraft, with which the company is allied through the Hawker Siddeley Group. The former is believed to be the most powerful British military powerplant in existence; the latter includes the revolutionary feature of moveable jet nozzles, so that all the power produced can be used all the time, whether in vertical posture or for conventional forward flight.

Patchway is only one of Bristol Siddeley's premises (their rocket division is at Ansty, Coventry), but it is here that the company's historical links are strongest, through their long family relationship with Bristol Aircraft at Filton. The aircraft company's works are on the other side of the airfield, with a helicopter test rig dominating the hill that stands between the factory and the city of Bristol. The long runway which was built for the Brabazon serves both Bristol Aircraft and Bristol Siddeley, providing both concerns with flying facilities "on the premises," unlike many companies which now have to trundle their aircraft by road to suitable test airfields.

* * *

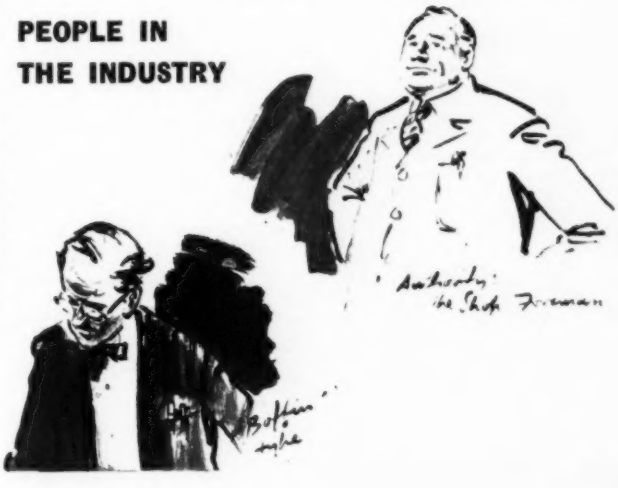
It was by chance that my next visit after Bristol Siddeley should have been to another great aero-engine company, Rolls-Royce, at their flight development establishment on Hucknall aerodrome north of Nottingham. This was formerly an RAF airfield and in pre-war days, when it was a grass area, housed one of the auxiliary squadrons. Now there is a long east-west runway (built by Rolls-Royce, which used to carry out test-flying at Tollerton), capable of handling V-bombers and Lightnings; but the surrounding countryside looks much the same: the coal-mining Nottinghamshire of D. H. Lawrence, with its pit-heads and slag-heaps, though the latter are gradually disappearing—for the hard-core, I was told, makes a useful contribution (once it has cooled off) to the undersurfacing of Britain's many current road-building projects. Away to the south-west of the airfield lie Ilkeston and Derby, the latter being Rolls-Royce headquarters, and a problem which the company's test pilots have to face is that of industrial haze blowing over with the south-west wind. Hucknall has GCA to assist their return in unfavourable conditions. To the east and north-east the pilots have the advantage of an area untrammelled by airways, though with a great deal of RAF traffic from stations in Lincolnshire.

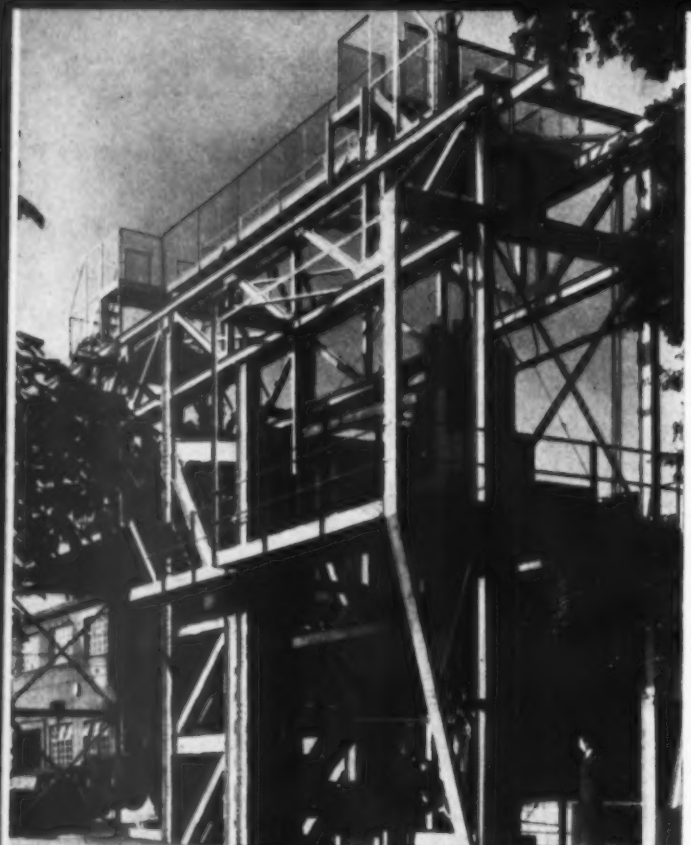
The test-bed aircraft at Hucknall give some idea of the development work being undertaken by the company. In one of the hangars were an Ambassador formerly used for type-testing Tynes but now being readied to take the latest and most powerful version of the Darts, the RDa.10s; a Lightning with the vivid rainbow of thermal paint lines on the rear of its jet-pipes; an engineless Vulcan; the Tyne Ambassador G-ALZR which recently completed 1,600hr flying in six months (much of it undertaken in the Mediterranean area); and an Avro Ashton, looking pensively as if it, too, would like to have been a *Cone of Silence* film star.

Out on the tarmac was a most interesting line-up of hard-working aeroplanes: a Meteor with under-wing fuel tanks, which form its main form of supply because an RB.108 VTO engine has been installed under the fuselage; the Dart Dakota G-37-2 (can Douglas have ever visualized their transport being thus powered, way back in 1933?); and the Tyne Lincoln G-37-1, with water-spray grid mounted in front of its test-bed engine, water being heated by a Palouste engine in the rear of the aircraft and fed through co-axial piping. A Javelin is also used for development testing at Hucknall, and a Heron has recently been acquired for communications duties.

Flight testing is only one aspect of work at Hucknall, the other main functions of the establishment being the ground development and testing of engine installation features—including aerodynamic, thermodynamic and mechanical problems—and the design, manufacture and development testing of complete power units. At one end of the tarmac is a test rig for investigating ground erosion, moveable so that effects on four different types of surface can be examined, and also for studying re-ingestion problems with VTO engines. Other facilities grouped at the north-east side of the airfield enable all aspects of engine installation to be examined under the most stringent conditions. There is, for example, a Derwent injector tunnel, and a Derwent blower rig used as a source for compressed air; a thrust measuring rig, used for various types of swivelling thrust; a fire tunnel, giving speeds of up to 300 m.p.h. and designed to prove not that fires can be countered but that they do not occur (I was reminded of the legendary story

PEOPLE IN THE INDUSTRY





Dowty undercarriage test rig at Arle Court, Cheltenham; it was originally built for the Brabazon undercarriage

Looking-in on the Industry . . .

of Rolls-Royce car engines, that "our big ends do not fail"); a supersonic wind tunnel giving Mach 1.8; a static rig devoted to noise-suppression tests, with concentric circles of white crosses, red crosses and white spots marked on the surrounding ground as positions for placing microphones. I was also shown the low temperature test facilities, where an engine can be cooled to any temperature down to −55°C, and where another cold room incorporates water-spraying equipment for testing components and carrying out icing tests on scale models. There is also a rotor icing test rig on which the behaviour of rotor blades under low temperature and humidity conditions can be studied. There is a low-speed wind tunnel (originally built as a mock-up) in addition to the supersonic one.

In seeing all these aspects of Rolls-Royce work at Hucknall, I was particularly impressed by the calibre of the staff there; the enthusiasm and knowledgeability of the engineers and research workers, the craftsmanship of the employees, and the wholehearted keenness of the pilots. All seem to combine into a team which helps to maintain and enhance the standards of Rolls-Royce aero-engines. Scarcely any production work as such is carried out at Hucknall; the emphasis is on research into the problems of installation and development.

* * *

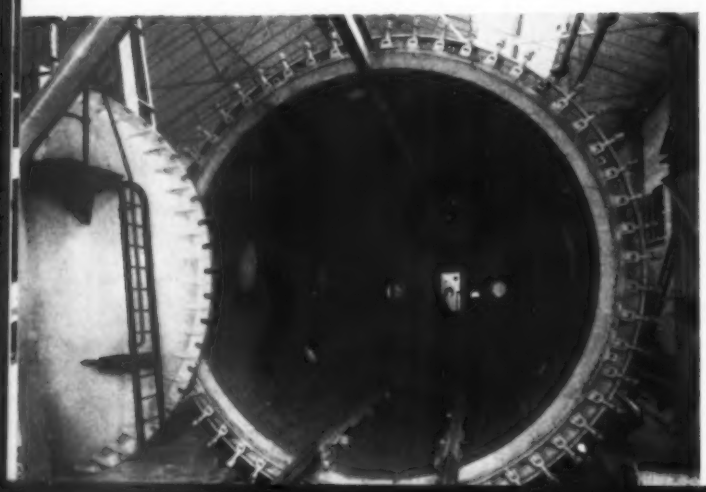
Trim flower-beds, blush-pink Vulcan B.2s, green foothills of the Peak District floating eastwards into a curtain of mist: such were my first impressions of the A. V. Roe test airfield at Woodford in Cheshire. I mention the flower-beds particularly, because they are the first thing seen by a visitor arriving by road. On either side of the wide drive which leads in from the entrance-gate are antirrhinum, michaelmas daisies and clematis (if my floral recognition is correct), softening the eye for the sterner things within. Straight ahead is one side of the vast production hangar, where hundreds of Lancaster bombers were assembled during the last war. This hangar is now largely taken up by the company's Weapons Research Division (*verboten* to visitors, though I saw some complete Blue Steels at the aircraft end of the hangar) and Vulcan B.2 assembly; while there are also some ex-RAF squadron Mk 1 Shackletons being converted into T.4s. When Shackleton work is taken over by de Havilland at Chester (newcomers to the Group) the spare space at Woodford is to be used for final assembly of Avro 748s, from parts made at the main A. V. Roe factory at Chadderton.

Blush-pink may not be the official description of the colour of the Vulcan B.2s, but that is certainly how they look, forming a striking contrast with the anti-radiation white of the B.1s; and the blue used for lettering and on the roundels of the B.2s is much paler than formerly, giving a somewhat unfinished appearance, almost as if it were an undercoat. The aircraft themselves have aesthetically lost some of the greyhound appearance of their predecessors: seeing both the B.1 and B.2 side by side at Woodford, I thought the differences in shape were very marked, with the latter's larger wing and bigger intakes, and bulge aft of the fin where formerly the fuselage was faired almost to a point. But considering the B.2's increased power and lethal qualities, it is hardly surprising that some of the Vulcan's simplicity of outline has been lost. The same sort of thing happens to most military aeroplanes in the course of the development, with the inclusion of additional operational requirements.

The production hangar is on the west side of Woodford airfield, and on the other side is a group of buildings dominated by the hangar where aircraft are made ready for flight testing. Within the latter was the first Avro 748, jacked up and being busily prepared for demonstration at Farnborough; and by contrast with this newest A. V. Roe product, outside the hangar and across the tarmac was the oldest object at Woodford—a white building which I was told dates from the 16th century and is now used as a club house, where visitors to the airfield are entertained. Next door to it are the original green hangars of the Lancashire Aero Club, which now operates from Barton airfield on the west side of Manchester. The 748 which is to make its public debut at Farnborough, G-APZV, carries temporary soundproofing and is chock-a-block with test-flight instrumentation. But two pairs of different types of seats were being installed (built to Avro specification) to show to potential customers.

Clustering round the flight assembly hangar are the types of equipment one expects to find nowadays at a test airfield: a 30in supersonic wind tunnel (capable of speeds up to Mach 3.5) with a blowdown sphere at one end of it; a transonic tunnel fed by two Nene engines; and a low-speed tunnel. Associated with them is a model shop. I learned that wind-tunnel work is being undertaken at Woodford on the Hawker P.1127. There is a test rig on which half of the Vulcan fuel system can be tested; an engine test-house, where runs on all marks of Bristol Siddeley Olympus engine can be undertaken; and structural test rigs. Structure test work on the AWA Argosy was done here, and the 748 fuselage is now taking its place on the rig. Inside the hangar, at the other end from where the 748 was situated, were two Vulcan B.2s and the last Shackleton to be built. On top of the hangar is what used to be the airfield control tower, now replaced by a modern building to the north of the main 2,000yd runway, which runs from east to west (260/080).

My initial reference to the Peak District foothills "floating into a curtain of mist" should not be taken to imply that the weather at Woodford is worse than anywhere else. In fact the hills to the east sometimes serve as a protective barrier for the airfield area. The special problem with which the Avro test pilots and controllers have to contend is that of being within the busy Manchester



Normalair high-altitude, high-temperature decompression chamber at Yeovil, where the company's premises adjoin those of Westland Aircraft

control zone, where IMC rules are now permanently in force. Ringway Airport, with its heavy traffic flow, is only four miles to the west (no distance at all, as modern aeroplanes fly); and flights from Woodford, which are irregular both as to time and duration, have to be fitted into the pattern. The airfield's radar (Cossor 21 is employed) is used under the jurisdiction of the Manchester Control Zone, controlling authority for all traffic. In practice the arrangement works quite well, for there is close co-operation between the Woodford and Ringway controllers, a tie-line linking the towers at both airfields. Sometimes an aircraft wishing to take off from Woodford may have to be held on the ground until Ringway gives clearance. In such a case, communication is entirely between the two controls; the pilot at Woodford talks only to his own tower. The equipment at Woodford's control tower (built on the usual two-storey pattern, with all-round view and adequate soundproofing upstairs) has been planned by the controllers according to their requirements. One advantage of the Cossor 21 is that it incorporates MTI (moving-target indication), enabling the clutter of hills to the eastwards (some of which rise to over 2,000ft within 20 miles) to be removed from the screen. Aircraft coming in from the east are brought down on a straight-in approach to the main runway; if they come from the west, Ringway puts them into a favourable position for the Woodford radar, at a distance of 8-10 miles out. UHF is also installed in the Woodford tower, for use with the Vulcans; and there is a Thermionic Airport Recorder which is used for recording the R/T conversation on test flights.

Flower-beds were my last, as they were my first, view of Woodford: this time outside the handsome new Technical Training School, only recently occupied, where RAF personnel—and in days to come, technical representatives of civil airlines using the 748—are taught the inner secrets of aircraft and weapons being produced by the busy and energetic Avro organization.

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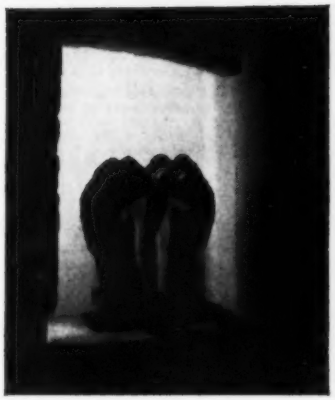
From Cheshire to the soft downlands of Surrey, to Dunsfold airfield in the south-west corner of the county, where Hawker Aircraft do their test and development flying. This was my last port of call, and appropriately a forward-looking one, since it is here that in the near future the Hawker P.1127 vertical take-off fighter will make its first flight.



High-altitude test plant at the Patchway factories of Bristol Siddeley Engines during a ramjet test; and at right, stator blades being cast in the precision foundry

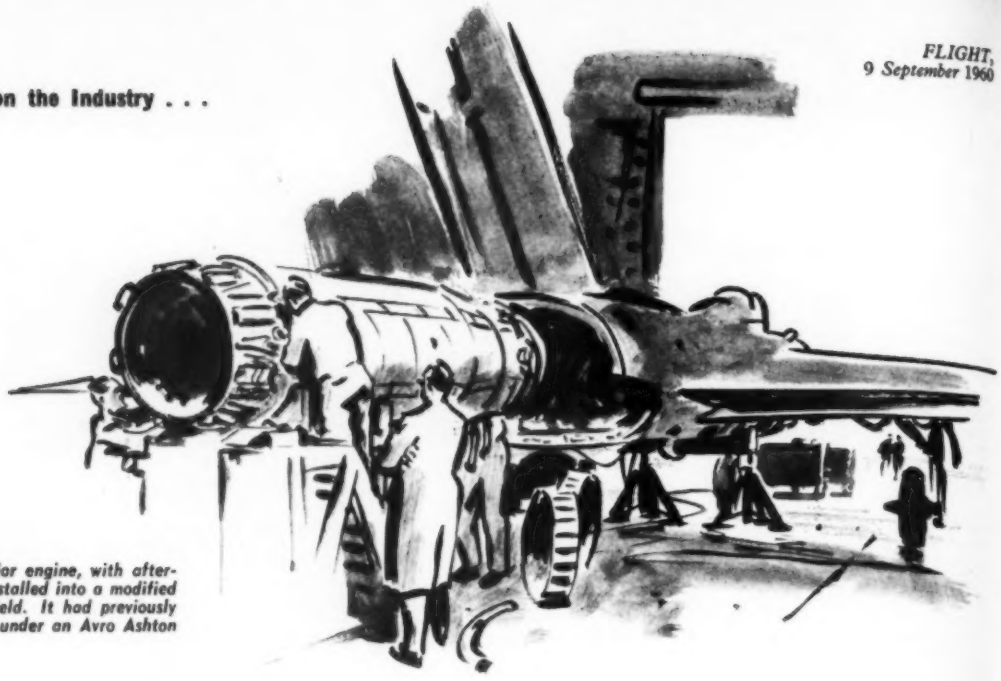
Dunsfold's history falls into three stages. The first is recorded on a white stone plinth which stands just outside the airfield control tower. This perpetuates a wartime ceremony (on October 16, 1942) when the GOC-in-C of the 1st Canadian Army, Lt Gen A. G. L. McNaughten, handed over the airfield for the use of the Royal Canadian Air Force. It had been built by the Royal Canadian Engineers after the woodland which previously covered the area had been cleared by the Canadian Forestry Corps. Thereafter it was used for medium bomber attacks on German-occupied Europe, and in support of the liberation forces. At the end of the war in Europe, aircraft of Bomber Command flew in to Dunsfold with repatriated POWs.

During the second stage in Dunsfold's history, in the late 1940s, the airfield was used as a base by Skyways; then the third stage began some ten years ago when Hawker Aircraft came there to carry out test and development flying. At that time, the company were still manufacturing Furies; but the subsequent history of the airfield has been largely associated with the development of the Hunter, still the front-line intercepter for the Royal Air Force and in use by air forces all over the world.

Hawker's service department has its offices at Dunsfold, but no manufacturing is carried out there. The aircraft are built at Kingston and brought to the airfield by road for assembly and

Trying to solve the big problem: noise suppression test at the Rolls-Royce installation and flight test development establishment at Hucknall, Notts

Looking-in on the Industry . . .



D.H. Gyron Junior engine, with afterburner, being installed into a modified Javelin at Hatfield. It had previously been test-flown under an Avro Ashton

flight testing. In the assembly hangar I saw FR.10s, the latest mark for the Royal Air Force, and Mk 56s and 66s for the Indian Air Force. There were also various Hunters in for Cat 4 repair, such as an F.6 and a T.7, and a Fury (G-9-38); while nine Furies with similar markings parked some distance away.

One attractive stranger in the assembly hangar was a Sopwith Triplane (N5912), which looked complete but does not in fact possess a working engine. Nearby stood the Hart J9933, which is in flying condition, and outside on the tarmac was the Hurricane PZ865 which still delights the public on its appearances at flying displays. In the paint shop which adjoins the assembly hangar the Hawker Hunter Two-seater G-APUX was being readied for its Farnborough demonstrations, with nearby one of the 350-gallon drop-tanks which it may be wearing during the week of the display.

Dunsfold airfield lies on the very edge of the London Terminal Control Zone, and only a couple of miles to the west of Gatwick Control Zone, so exceptional care is required of the test pilots and controllers in flying operations. The airfield lies below Airway Red One, which leads into the Southampton Control Zone, but to the south and north of the airway there are relatively clear areas for test-flying. Dunsfold, like Woodford, is equipped with Cossor 21 radar, and it is planned in the near future to modify this to 704-type equipment. In addition to VHF, there is a UHF installation, and some of the Hunters being test-flown are fitted with DME which can be used in co-operation with RAF stations like Tangmere and Chivenor. The point was made to me by the airfield controllers that the equipment in the aircraft is not of their choosing, but depends upon the requirements of Hawker customers. They paid tribute to the test pilots for their intelligent use of the equipment. Normally, take-offs are made towards the west on the 2,300yd main runway (the other two runways are used mainly for light aircraft, and are not kept in a full state of repair). When take-offs are made towards the east, aircraft usually make a smart turn to port to avoid entering the Gatwick Control Zone.

A new stage in Dunsfold's history is shortly to begin, when the first flights of the Hawker P.1127 are made from there—probably before the end of the year. This VTOL tactical machine implies an entirely new development in the great tradition of Hawker military aircraft.

Flying it will impose some special problems on the company test pilots who are to undertake the work. Instead of the normal aileron and elevator movements which have been accepted as standard in half a century of aviation, the new techniques to be learned include hovering flight and the judgment of rates of ascent and descent without the normal points of reference which pilots have come to accept almost instinctively. Further, ground erosion problems have to be studied, as has already been seen in the case in Rolls-Royce research at Hucknall—although the special character of the Bristol Siddeley engine should minimize this problem.

The Hawker chief test pilot, A. W. (Bill) Bedford, and his deputy H. C. H. Merewether have already made some study of VTOL problems by looking at the Viper-powered Bell X-14 VTOL swivelling-nozzle research aircraft in California and by taking a helicopter course in this country. During the early stages of P.1127 flying they are going to continue gaining helicopter experience. But the new problems they face will have to be solved as they arise; even an aircraft which has been going for ten years, like the Hunter, still poses some new questions. There is no doubt, however, that the research and engineering skill at Kingston and the flying skill at Dunsfold will combine to find satisfactory answers with the P.1127.

Dunsfold, the former wartime airfield situated in one of the most beautiful parts of Surrey (its grass areas, I was told, produce a handsome crop of mushrooms), is one of the thresholds of new developments in British aviation. It was by chance that my visits to the British aircraft industry ended there, though the chance was significant. Though I was not allowed to see anything of the P.1127 programme I could sense an excitement in the air. The Hunter generation is now ending, and the line of Furies (with the Hurricane and Hart looking still farther back) gave Hawker history at Dunsfold a further perspective. The future is now with the P.1127, as with the TSR.2 at Warton, the VC10 at Weybridge and the Trident at Hatfield.

Danger! artist at work: the industry looking-in on Gordon Horner

THE FLYING-DISPLAY PILOTS

Forty-eight Industry Test Pilots who are Demonstrating Aircraft at this Week's Show

Abbreviations: A and AEE, Aeroplane and Armament Experimental Establishment; AFRAeS, associate fellow, Royal Aeronautical Society; ARB, Air Registration Board; ATA, Air Transport Auxiliary; BAFO, British Air Forces of Occupation; CFE, Central Fighter Establishment; CFI, chief flying instructor; CFS, Central Flying School; ETPS, Empire Test Pilots' School; FAA, Fleet Air Arm; FTS, flying training school; GAPAN, Guild of Air Pilots and Air Navigators; MU, maintenance unit; OTU, operational training unit; PFF, pathfinder force; RAE, Royal Aircraft Establishment; RAFO, Reserve of Air Force Officers; RAFVR, Royal Air Force Volunteer Reserve; RAuxAF, Royal Auxiliary Air Force; TAF, Tactical Air Force; UAS, University Air Sqn

Flt Lt J. W. Allam (*Victor B.2*): Deputy chief test pilot of Handley Page, which he joined in 1954 after serving with the RAF and RAFVR since 1942. Pilot of the first Victor to fly at supersonic speed; made first flight of Victor B.2 on February 20, 1959. Took No 9 ETPS course and No 5 course, Test Pilot Training Division, US Navy; with "B" Sqn, A and AEE, 1951-53.

C. Allen (*Avro 748*): After production and experimental test flying with Vickers-Armstrongs (Weybridge) from 1952-59, joined A. V. Roe and was co-pilot on the first Avro 748 flight. Served with the RAF from 1943, flying Mosquitos with No 540 (PR) Sqn. After leaving the RAF in 1947, flew with Central African Airways. Then flew with BEA and at the same time was a pilot with No 604 Sqn, RAuxAF.

Sqn Ldr P. P. Baker (*Victor B.2*): Entered RAF in 1943; flew Sunderlands (1946-49) with Nos 201, 209 and 239 Sqns. Attended CFS course, then (1950-52) was instructor at FTS and advanced FTS. Took No 12 course, BTPS, in 1953; at A and AEE, Boscombe Down, 1954-56. Tutor at ETPS, 1957-59; in July 1959 retired from RAF to join Handley Page.

Wg Cdr R. P. Beamont (*Lightning*): Deputy chief test pilot, British Aircraft Corporation, and chief test pilot of English Electric. Had a distinguished wartime career in the RAF, in which he served from 1938. Commanded No 609 (West Riding) Sqn, with whom he introduced the day-and-night "train-busting" technique, and Nos 122 and 150 Wings. During the anti-flying bomb offensive destroyed 32 of these weapons. Taken prisoner in 1944; on returning to this country commanded the Air Fighting Development Sqn at the CFE. Is an OBE; holds the DSO and DFC.

A. W. Bedford (*Hunter*): Chief test pilot of Hawker Aircraft, having joined the company in 1951 after being at the RAE Farnborough (1950-51). Entered the RAF in 1940 and served with Nos 135 and 605 Sqns in the Far East; in 1944 was a flight commander at the Armament Practice Camp and the following year went to No 65 Sqn, becoming a flight commander. Attended the ETPS where he was OC Instrument Weather Flight in 1949. Holds many gliding records and a Gold "C" with two diamonds. Appointed Hawker chief test pilot in 1956.

A. L. Blackman (*Vulcan*): Test pilot with A. V. Roe since leaving the RAF, which he joined in 1948 after taking an Honours degree in physics at Cambridge University. Flew with Nos 5 and 11 Sqns in 2nd TAF, then took the BTPS course, gaining a distinguished pass. With "B" Sqn at the A and AEE until August 1956.

J. Blair (*Twin Pioneer*): Joined Scottish Aviation in 1947, after having served in the RAF (1940-46), flying Liberators in Coastal Command. Qualified instructor and airline captain. Has taken a part in experimental and production test-flying of Pioneers and Twin Pioneers, as well as sales demonstration tours and operations overseas.

R. S. Bradley (*Wessex*): Assistant chief test pilot of Westland Aircraft, having joined the company in 1950 as an experimental test pilot. Served in the FAA (1941-46), flying with No 1833 Sqn and later as CO of the Command Flight at Donibristle. After the war became chief test pilot of Helliwells Ltd.

T. W. Brooke-Smith (*SC.1*): Short Bros & Harland's chief test pilot. Has carried out much research and experimental flying on land and marine aircraft during 20 years' test flying and has recently been responsible for the entire SC.1 test-flying programme. This year demonstrates the principle of jet VTOL which he has helped to pioneer. He retires to go into business at the close of this year's SBAC flying display.

G. R. Bryce (*Vanguard*): Chief test pilot of British Aircraft Corporation since July 1960, having previously held a similar appointment with Vickers-Armstrongs (Aircraft). Started flying in 1939, when he entered the RAF. Subsequently served in Fighter, Coastal and Transport Commands and with the King's Flight. Is an OBE.

J. G. Burns (*NA.39*): Joined Blackburn Aircraft in January 1959 after being with Hunting Aircraft since February 1958. Previously served in the RAF, which he entered in 1946 as a Cranwell cadet. With No 56 Sqn; went to CFS in 1951; took No 13 ETPS course in 1954; at the A and AEE from 1956 to 1957. Has been awarded two Queen's Commendations for Valuable Services in the Air.

W. R. Burton (*Dart Herald*): Joined Handley Page in 1948. Served with the RAF (1938-39), becoming EFTS instructor until the outbreak of war, when he rejoined the RAF and served in Training Command in Canada, Atlantic Ferry Training Command, Coastal Command VLR Sqn and HQ Coastal Command. In 1945 joined BEA and flew Vikings.

C. A. Capper (*Sea Vixen*): Joined de Havilland in 1953 as an experimental test pilot, having started flying in the RAF in 1942. Flying instructor in Canada, 1943-44; test pilot at No 308 MU, Allahabad, 1946; with No 4 Sqn in BAFO, 1946-48, before going to the ETPS. Test pilot at the Aero Flight, Farnborough, 1949-52. Chief test pilot, D.H. Christchurch, since Jan 1959.

Wg Cdr N. J. Capper (*Twin Pioneer*): Chief test pilot and flight manager of Scottish Aviation, which he joined in 1936. Learned to fly at No 2 FTS, Digby, in 1929; served in the RAF until 1934 and then again from 1939 to 1944. Has flown 8,000hr as an airline pilot, flying instructor and test pilot. Holds the AFC.

Wg Cdr J. L. Dell (*Lightning*): Appointed deputy chief test pilot of English Electric in December 1959. From 1957 was Fighter Command Liaison Officer, taking an active part in the development programme of the Lightning. Joined the RAF in 1942; has been a flying instructor and completed a tour of operations with the USAF (1952-54).

Flt Lt J. W. Allam

C. Allen

Sqn Ldr P. P. Baker

dr R. P. Beamont

A. W. Bedford

A. L. Blackman

J. Blair

R. S. Bradley

T. W. Brooke-Smith

G. R. Bryce

J. G. Burns

W. R. Burton

C. A. Capper

Wg Cdr N. J. Capper

Wg Cdr J. L. Dell

Sqn Ldr L. De Vigne

W. H. Else

E. G. Franklin

Sqn Ldr W. R. Gellatly

Sqn Ldr J. G. Harrison

THE FLYING-DISPLAY PILOTS . . .

Sqn Ldr L. De Vigne (*Gnome Whirlwind*): Test pilot with Westland Aircraft since 1953, having served in the RAF from 1940 to 1951. Won the DSO and DFC serving with No 627 Sqn (Mosquitos) in the PFF. Test pilot with No 41 Group, Maintenance Command, 1945-46; took No 6 ETPS course, 1947; Service and civilian test pilot with RAE Farnborough, 1948-52, being awarded AFC. Chief test pilot, Armstrong Siddeley Motors, 1952-53. Carried out initial test flights on the deflected jet Meteor (Nene).

O. J. Hawkins

Sqn Ldr H. G. Hazelden

P. Hillwood

C. T. D. Hosegood

J. J. M. Jeffery

D. McM. Knight

J. O. Lancaster

J. G. McCowan

W. H. Else (*Argosy*): Joined Armstrong Whitworth as a test pilot in 1947. Served with the RAF from the age of twenty, doing his initial training in Britain and becoming one of the first English pilots to train in the US. Flew fighters and fighter-bombers during the war, doing low-level attacks on pin-point targets. Was appointed to an OTU and then seconded to do armament trials at Boscombe Down. After joining AWA, attended the ETPS. Flew as second pilot on the Apollo's first flight and has also flown prototype machines for the company.

E. G. Franklin (*Argosy*): Chief test pilot of Armstrong Whitworth Aircraft since January 1948, having re-joined the company (with whom he had been an apprentice) in 1945 as a test pilot. Served during the war with Nos 78 and 35 Sqns (Whitleys and Halifaxes), winning the DFC and being awarded the AFC for instructional duties. Started test-flying in 1942, before completing a second tour of operations (in the PFF). Attended No 2 course at the ETPS in 1944, before going to the A and AEE and then to AWA.

Sqn Ldr W. R. Gellatly (*Rotodyne*): Joined the RNZAF in 1940. Between 1942 and 1945 did 77 light bomber and GR operations; from October 1944 to July 1945 commanded No 293 Sqn RAF; permanent commission, May 1947. CGI at No 231 OCU, 1947-48; flight commander, No 139 Sqn, until February 1950. ETPS course, 1950; helicopter flight commander at A and AEE, 1951-54. RAF Staff College course, 1954-55, then joined Fairey Aviation. Council member, Helicopter Association, 1953-55 and May 1956-May 1959.

Sqn Ldr J. G. Harrison (*Avro 748*): Chief test pilot of A. V. Roe since January 1958; joined the company as a test pilot in February 1954. Entered the RAF as an apprentice in 1935; started flying in 1941. Completed training in Canada and became an instructor there. In 1944 posted to a Mosquito OTU and then served with No 605 Sqn in 2nd TAF. ETPS course, 1949; joined the aerodynamics flight at the RAE, being awarded the AFC. Has flown 87 types of aircraft.

O. J. Hawkins (*Vulcan*): In 1958 joined A. V. Roe after test flying with Gloster Aircraft Co. Served with the RNZAF in 1942, flying P.40s and Corsairs; came to England in 1951 to join RAF. Appointed to RAE 1954 and subsequently to ETPS. After completing the course, flew with "A" Sqn at Boscombe Down.

Sqn Ldr H. G. Hazelden (*Dart Herald*): Appointed chief test pilot of Handley Page three months after joining the company in 1947. Flew Hampdens with No 44 Sqn during the war, winning the DFC and Bar. Subsequently instructed at No 14 OTU then went to No 83 Sqn. Took the ETPS course and went to the A and AEE, later commanding the Heavy Aircraft Test Sqn. Appointed OC the Civil Aircraft Test Section and awarded a King's Commendation. Received the Queen's Commendation in 1958.

P. Hillwood (*Lightning*): Began test-flying in 1945, while still in the RAF, following instructional duties. Pilot on the return journey of the Canberra which on August 26, 1952, made a record two-way Atlantic crossing in 10hr 3min 18.13sec at an average speed of 605.52 m.p.h. With R. P. Beamont was awarded the Britannia Trophy for this flight. In February 1956 set up an official London - Cairo record of 551.8 m.p.h. in a Canberra B.8.

C. T. D. Hosegood (*Belvedere*): Bristol Aircraft chief helicopter test pilot since 1951. Served in the Fleet Air Arm during the war, being appointed to the first armed merchant cruiser to be fitted with a catapult. One of the first Naval pilots sent to the USA for helicopter training, serving with various experimental units after his return to the UK in mid-1944 and on loan to the RAF at Beaulieu, where the Helicopter Experimental Unit originated. Joined the Bristol Aeroplane Co in 1948, to assist in helicopter test and development flying.

J. J. M. Jeffery (*Sheeter*): Helicopter test pilot with Saunders-Roe since 1950, having served in the FAA from 1940 to 1946. In 1944 took a helicopter instructor's course in the US, later becoming helicopter instructor and test pilot at the Aerial Torpedo Development Unit. Instructor and senior helicopter test pilot at the Air/Sea Warfare Development Unit, 1945-46.

D. McM. Knight (*Lightning*): Began flying with the RAF in 1949, and from 1951 to 1954 was a member of No 603 (City of Edinburgh) Sqn, RAuxAF. Joined English Electric in June 1953.

J. O. Lancaster (*Argosy*): Test pilot with Armstrong Whitworth Aircraft since 1949, having been an apprentice with AWA in 1935. In 1937 joined the RAFVR and after the outbreak of war did a multi-engine conversion course. Flew with Bomber Command and took part in the daylight raid on Brest. Was awarded the DFC. With the A and AEE, Boscombe Down, then joined Boulton Paul as a test pilot. Later transferred to Saunders-Roe and flew the SRA.1.

J. G. McCowan (*Argosy*): Test pilot with Armstrong Whitworth Aircraft. Joined the RAF as a Boy Entrant and in 1938 volunteered for flying duties. Did his flying training in Canada and returned to England in 1943. Served in India and Singapore, flew with a fighter squadron on the North-West Frontier and later became a rocket-firing instructor. After leaving the Service, was maintenance test pilot with Airwork before joining AWA.

Wg Cdr R. F. Martin (*Javelin*): Joined Gloster Aircraft in 1953 as chief test pilot. After training at Cranwell (1937) flew with No 73 Sqn, Advanced Air Striking Force (1939-40); awarded DFC. Served in North Africa (1941) and awarded second DFC. Chief test pilot to 107 MU (1942-43); posted to Transport Command (1944). Took ETPS course in 1946 and appointed Flight Commander at RAE. Awarded AFC. Staff instructor at ETPS and attended No 2 course, RAF Flying College (1951). Before joining Glosters served in the Air Ministry. Pilot to the Shuttleworth Collection.

H. C. H. Merewether (*Hunter*): A South African who joined Hawker Aircraft as a test pilot in 1954 after serving with the FAA (1943-46) and being trained as a pilot by the US Navy (1944-45). In the RAFVR (1947-51) and with No 615 Sqn, RAuxAF (1951-56). Before joining Hawker was with Vickers-Armstrongs as a technician in the research and development dept.

Lt Cdr J. G. P. Morton (*Rotodyne*): Joined Fairey Aviation as a test pilot in September 1955, having previously been lent to the company by the Royal Navy, which he joined in 1943. Received flying training with the US Navy, then became a flight commander in No 1835 Sqn (1944-45), later serving in HMS *Colossus* and *Theseus*. Flight commander, helicopter flight, Underwater Development Establishment (1949-50); subsequently at CFS, with No 705 Sqn, at the A and AEE and in HMS *Centaur* until lent to Fairey Aviation in March 1955.

Wg Cdr R. F. Martin

H. C. H. Merewether

Lt Cdr J. G. P. Morton

THE FLYING-DISPLAY PILOTS . . .

P. Murphy (*Victor B.2*): Joined Handley Page in 1958 after being with Vickers-Armstrongs (Aircraft) since 1951 as an experimental test pilot, engaged in Valiant and Viscount development. Had previously served in the RAF, qualifying as a pilot in 1947 and from 1948 to 1951 serving with Nos 56 and 66 (day-fighter) Sqns. Was aerobatic team leader and, flying Meteors, took part in many displays including that for the Festival of Britain in June 1951.

R. M. Oliver (*Gnat*): Joined Folland Aircraft as a test pilot in 1957. Flew fighter aircraft during the war with the RAF (in the Battle of Britain and from Malta) and after the war with No 600 (City of London) Sqn, RAuxAF. Before joining Folland was chief development engineer with the Connaught Engineering Co, working on and driving Grand Prix racing cars.

S. B. Oliver (*Jet Provost*): Chief test pilot of Hunting Aircraft, which he joined in 1954. Entered the RAF in 1942 and was commissioned in 1945, transferring to the Royal Navy (Air Branch) later that year. Did an instructor's course at the CFS and took the ETPS course in 1950. Was Naval test pilot at the A and AEE (1951-52).

J. R. S. Overbury (*Jet Provost*): Joined Hunting Aircraft in 1959 from Saunders-Roe, with whom he had been since 1956, undertaking development flying on the SR.53. Had previously served in the Royal Navy since 1943, being granted a permanent commission in 1950. With Nos 816 and 810 Sqns (HMS *Ocean* and *Theseus*); CFS course, 1950; ETPS course, 1953; Naval Test Sqn, A and AEE, 1954-56. Holds point-to-point records for London - Amsterdam in a Sea Hawk, Rome - Malta in a Sea Venom. Won D.H. Trophy in 1954. Did initial deck-landings in D.H.110 (Sea Vixen).

G. R. I. Parker (*NA.39*): Having served in the RAF and FAA and been a test pilot at the RAE, joined General Aircraft in May 1948. His flying there included the tail-less glider, and whilst with Blackburn & General Aircraft carried out the first flight of the H.P.88, the Victor scale model. Holds the DFC and Bar, AFC, DSM and a King's Commendation and has twice been mentioned in despatches.

H. Phillips (*Sprite*): Joined Saunders-Roe in 1958 as a helicopter test pilot, having been on helicopter testing since 1955 at the A and AEE. Previously served in the Royal Navy from 1934, training as a FAA pilot in 1939. Was commissioned in 1943. After serving in HMS *Illustrious* and *Formidable* completed a helicopter course in 1949. From 1950 to 1952 was with the US Navy, then commanded Nos 706 and 845 Sqns (1953-55).

K. M. Reed (*Gnome Wasp*): Appointed Saunders-Roe chief helicopter test pilot in 1958, having joined the company in 1952 as senior helicopter test pilot. On July 14, 1959, became the first helicopter pilot to be awarded a GAPAN Master Air Pilot (Test Pilot) Certificate. Served with Imperial Airways before joining the FAA in 1941. Two years later took a helicopter flying course in the US and in 1944 a helicopter maintenance test pilots' course. Formed No 1 RN Helicopter Flight in 1945 and two years later formed and commanded No 705 Sqn. In 1949 joined Westland Aircraft as senior helicopter test pilot.

P. Murphy

R. M. Oliver

S. B. Oliver

R. N. Rumbelow (*Jet Provost*): Joined Hunting Aircraft in April 1957 after serving in the RAF since 1951. Was with No 208 Sqn in the Middle East from 1953 to 1955, then a flying instructor for the following two years. Winner of the Wright Jubilee Trophy for aerobatics in 1956.

W. H. Sear (*Westminster*): Seconded to Westland Aircraft in 1953 after completing the ETPS course in 1951 and being posted to "C" Sqn, A and AEE, Boscombe Down. Served in the RAF from 1942 to 1945, transferring in the latter year to the FAA, in which he was with No 891 and subsequently Nos 812 and 816 Sqns. After taking a CFS course was appointed Naval instructor at RAF Syerston.

C. W. Simpson (*Argosy*): Joined Armstrong Whitworth Aircraft as a test pilot after being on the RAF handling squadron at Boscombe Down. Originally joined the RAF in 1942, training in Canada and staying there as a flying instructor until 1944. Next year transferred to the FAA and on demobilization returned to Loughborough College. Spent two years as a technical assistant with Bristol Aero Engines then rejoined the RAF in 1950, serving as an instructor with Flying Training and Coastal Commands (1951-1956) before going to Boscombe Down.

Sqn Ldr E. A. Tennant (*Gnat*): Chief test pilot of Folland Aircraft, having joined the company in June 1953. Served with the RAF during the war on No 256 Sqn (Defiants) and No 257 Sqn (Typhoons) and was awarded the DFC. In 1949 went to the ETPS, Farnborough, and thence to the A and AEE at Boscombe Down, where he remained until joining Folland Aircraft.

G. F. Thornton (*Dove*): Joined de Havilland Aircraft from the RAF in 1949 as a production and development test pilot at Hatfield and is now attached to the sales department. Trained in the US (1942-43) and flew Mustangs and Spitfires with No 2 Sqn, 2nd TAF (1944-45). Was with No 208 Sqn in Palestine (1947), then at the CFE. West Raynham, for his last two years of RAF service. Holds the DFC.

E. B. Trubshaw (*Vanguard*): Chief test pilot of Vickers-Armstrongs (Aircraft) since July 1960. Before joining Vickers in 1951 was a King's Flight pilot (from August 1946 to December 1948) and on the staff of the Empire Flying School at Hullavington during 1949. Later he was on the staff of the RAF Flying College at Manby.

P. W. R. Varley (*Argosy*): Test pilot with Armstrong Whitworth Aircraft, which he joined after four years with Gloster Aircraft, where he was deputy chief test pilot. In the RAF from 1941, flying with No 89 Sqn in Singapore. Left the Service in 1947, but rejoined the following year, with a permanent commission. Flew Hornets with No 19 Sqn, took CFS and ETPS courses and was with "A" Sqn at the A and AEE.

J. R. S. Overbury

G. R. I. Parker

H. Phillips

K. M. Reed

P. M. R. Walton (*Argosy*): Started test flying with Armstrong Whitworth Aircraft in 1953, after a short time on the company's design staff. Joined the RAF in 1942 and later instructed at South Cerney and Church Lawford. Left the Service in 1948, obtaining a BSc at Birmingham University in mechanical engineering. Joined No 605 (County of Warwick) Sqn, RAuxAF, in 1949, becoming CO in 1951.

D. J. Whitehead (*NA.39*): Qualified as a pilot in the RAF in May 1945, three months later transferring to the Royal Navy, his service including a wide experience of many different types of aircraft. Took ETPS course in 1954, and the following year appointed to the Naval Test Squadron at Boscombe Down, where he flew 41 different types and evaluated the Scimitar from the first prototype and deck-landing assessment through to the CA release. Awarded AFC for this work. Was Lt Cdr on a permanent commission before retiring from the Navy to join Blackburn.

G. Worrall (*Javelin*): Chief production test pilot with Gloster Aircraft since 1954, having joined the company in 1950. Previously served with the RAF (1941-48), then with No 616 Sqn, RAuxAF. Has over 2,600hr on different types.

R. N. Rumbelow

W. H. Sear

C. W. Simpson

Sqn Ldr E. A. Tennant

G. F. Thornton

E. B. Trubshaw

P. W. R. Varley

P. M. R. Walton

D. J. Whitehead

G. Worrall

Testing Circumstances

ROUTINE OF THE TEST PILOT'S DAY

SOMEWHERE someone somehow still imagines that a test pilot roars along to his airfield in a fast sports car, leaps into an aeroplane, flies it, then puts his feet up on a desk for the rest of the day. But this figure, if he ever really existed, is mythological. The days of "You think; I fly" have gone for good. The modern test pilot forms the last link in the complex chain that puts a new aeroplane into service; he not only has to carry out tests to a required engineering and aerodynamic pattern, but has to be thoroughly versed in the complicated procedures that modern flying entails.

In the case of civil aircraft, test pilots may have to turn themselves into airline pilots for demonstration tours, and this adds to their responsibilities. But how efficiently these are shouldered can be seen in the case of the pilots who have done the flying on the AWA Argosy, which was due to receive its C of A around the beginning of this month, at the Armstrong Whitworth Aircraft test airfield at Bitteswell in Leicestershire.

This is situated due north of Rugby, on the east side of the A5. From the road, not much is visible except for some black hangars and a control tower; though this is not surprising as most of what goes on happens on the far side of the airfield. Here the Argosies which have been brought by road from the Baginton factory of Armstrong Whitworth Aircraft are assembled for test and development flying; and at one end of the hangars is a single-storey building (which used to be the officers' mess when Bitteswell was an RAF airfield) with gladioli and hollyhocks growing outside the windows. This is where the AWA pilots have their offices.

The term "offices" is advisedly used in the plural sense, because each of the seven-man team (with the exception of two who share) has his own office. This is to provide suitable opportunities for concentration when writing up their reports. The chief test pilot, Eric Franklin, believes that the days of room-sharing in a chummy conversational atmosphere have gone for good. There is so much writing to be done that a pilot needs to work uninterruptedly.

Franklin himself came to Armstrong Whitworth as a test pilot in 1945, when the company's chief test pilot was C. K. Turner-Hughes, and became chief test pilot in 1948. He had been an AWA apprentice, then had a distinguished career in the RAF as a bomber pilot and instructor, and was on No 2 course at the Empire Test Pilots' School. His deputy at Bitteswell is W. H. (Bill) Else, who joined the company in 1948 after serving in the RAF as a fighter pilot, then took the ETPS course. From their long association in AWA, Franklin and Else have a close understanding, and together they undertook the prototype Argosy flying from the aircraft's first flight on January 8 last year.

Varied Experience

Since that date, however, the five other pilots have been brought in to Argosy work and share the flying. This is especially important when two of the team may be away for long periods, on extensive route-proving such as has been undertaken this year. The other five pilots are J. O. Lancaster, who joined the company as a test pilot in 1949 (having, like Franklin, been an AWA apprentice before the war) after serving with distinction in Bomber Command; C. W. (George) Simpson, who came to AWA from the RAF handling squadron at Boscombe Down; Jim McCowan, whose war service as a pilot was in India and the Far East, having volunteered for flying duties after joining the RAF as a boy entrant; Martin Walton, a former CO of No 605 (County of Warwick) Sqn, RAuxAF, and a BSc graduate of Birmingham University; and Peter Varley, the latest member of the AWA test team, who was formerly with Gloster Aircraft as deputy chief test pilot after serving with the RAF and taking the Central Flying School and ETPS courses.

The team which Franklin heads is clearly one of rich and varied experience, and the headquarters it uses has been planned to give the best possible working conditions. In addition to the separate offices, there are changing rooms, with shower facilities. It is as necessary for test pilots to get into the right clothing as it is for them to change out of it after flying. The offices also house a small secretarial staff, who look after administration (as well as making coffee) and transcribe the Wirek recordings made during flight. These, with the films taken of instrumentation equipment, plus personal impressions, form the basis of the pilots' reports.

Just across the road from the test pilots' offices is the flight test section, and its physical proximity brings home the truth of the remark about test pilots being the last link in a complex chain. What the pilots are called upon to do in flight is based upon the flight test schedules prepared by the section. These state the particular requirements, plus limitations and the loading of the aircraft for the operation envisaged. Once a flight has been carried out, the long process of computation and documentation of results begins; and reports may not be completed for several days.

Two pilots are carried on Argosy flights, not only because this is the official minimum crew complement but also for the very practical reason—as Franklin put it—that "another pilot can assist with the primary controls when you're getting 'near the bone'" on certain tests. Stalling and three-engine take-offs are obvious examples. Often the test crew carried numbers 11 or 12, so that all departments concerned with the aircraft are represented; and there is great keenness among AWA ground personnel to fly.

Three of the AWA pilots, Franklin, Lancaster and Walton, live in Leamington and have to drive 20 miles to their day's work; Else lives in Nuneaton (he is a keen member of the local golf club), Simpson between Baginton and Bitteswell, and Varley at Lutterworth, which is near to Bitteswell Aerodrome. For all of them, the day's work varies in character and duration. In theory the working hours are from 9 a.m. to 5 p.m., but often test flying may have to be done early in the morning or late in the evening when the air is smoothest.

On a typical day recently three Argosies were being test-flown from Bitteswell. G-AOZZ, the first aircraft, was doing autopilot work with Smiths Aviation Division representatives on board; G-APRL, temporarily converted to AW.660 configuration, was carrying out a short programme of handling tests with the rear "crocodile jaw" door open; and G-APRM was doing partial climbs associated with three-engine take-offs. (These are now scheduled in the flight manual.

Some details of the second two of this day's tests indicate the amount of research flying that has to be done. In the case of Romeo Love, there were three distinct test schedules to be carried out—door engineering, lateral control development, and performance with the doors open. This was to take three hours, with four people on board. Romeo Mike's tests were all being carried out below 2,000ft, in various configurations; but because of unfavourable weather conditions the flight had to be abandoned.

Avoiding Airways

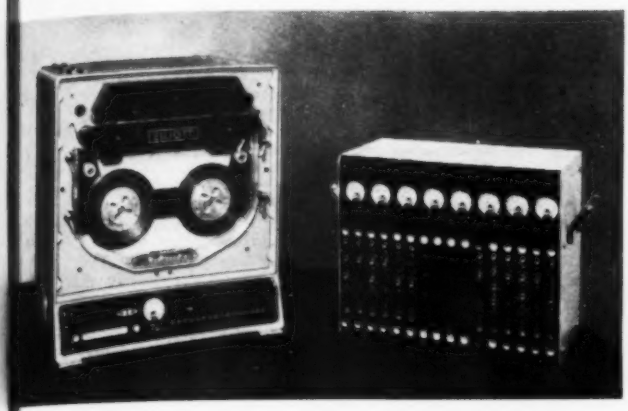
No longer is it possible for a test pilot's work in the air to be carried out informally, without reference to anyone (when Franklin came to AWA in 1945, there was not even any radio in use). Bitteswell suffers as much as any test airfield from the encumbrances of an airway (Amber One passes directly over it at 3,000ft) and an adjacent control zone, the Birmingham Control Zone being only ten miles away. This means that the pilots' main difficulty, as Franklin puts it, lies in "avoiding airways." If flying is done to the south-west (Franklin's personal preference), the problem arises of getting back through Amber One, which means informing the controllers. Coming back underneath it would waste time. But as the airway rises to 25,000ft the former course is likely to be adopted. Another problem is that of low-altitude flying, which "tends to be the hardest to get done." If it is carried out to the north-east (clear of airways), there is a busy complex of RAF airfields to be avoided. Directly to the east, the area is clearer of Service aircraft.

Bitteswell has the USAF base at Bruntingthorpe, operating RB-66s, as a close neighbour; in fact the two main runways are almost in a straight line. When *Flight's* Gemini flew in to Bitteswell, the controllers warned that a VHF call should be made about 15 miles away "as Bruntingthorpe is very active." This was done; and shortly after the Gemini landed at Bitteswell and was taxying in an RB-66 swept low and fast over the airfield.

There is close co-operation between Bitteswell and Bruntingthorpe, by tie-line between the two airfields, and the Bitteswell controllers have Marconi 232 radar to watch their own aircraft. This gives a surveillance area of 80 miles and all flying is done with radar coverage. The AWA aircraft are approved to carry out climb-out procedure through Amber One, but normally test flying is done towards the east. On an average, four or five hours' handling work is carried out during the day; some night flying is done, but not generally as a deliberate procedure. However, if conditions for completing a particular test are favourable and daylight runs out, it is continued into the darkness. After all flights, an experimental flight test report has to be compiled; and there are monthly flight development committee meetings to be attended, and weekly sub-committees.

This, then, is the pattern of work at one manufacturer's test airfield: a conscientious and skilled team forming a close link with the flight test section. Now that Armstrong Whitworth Aircraft are on the tail-end of their Argosy C of A flying, and the Pilot's Notes have been completed, the pace will probably slacken for a while; production aircraft will not involve such stringent testing.

The test pilot's work can hardly be called routine, for it may often involve unexpected complications. Skill, experience and the right sort of temperament are the qualities needed, and you can find them on the far side of Bitteswell Airfield. H. W.



The new Elliott tape recorder, showing simplified controls and, right, the record and playback amplifier chassis

FLIGHT SYSTEM SURVEY

BOAC Order Marconi 60 Series

IT was announced just before the SBAC Show began that BOAC have placed an order with Marconi's Wireless Telegraph Co for the new 60 Series range of airborne radio equipment for their whole fleet of 35 Vickers VC10s. The 60 Series was first described in *Flight* for August 19. About 1,400 main units will be required.

New Elliott Tape Recorder

A MULTI-CHANNEL tape recorder just announced by Elliott Brothers (London) Ltd is designed primarily for aircraft flight testing and missile telemetry work, but also has outstanding voice reproduction characteristics for studio use. It can record frequencies up to 70kc/s or a three-day sequence of signals, the most important feature being the new head construction and tape-transport arrangement.

The recording and play-back heads are based on a laminated structure ensuring optimum magnetic properties and azimuth alignment between tracks on a production basis. The tape transport system has dual capstans and take-up mechanisms which reduce disturbance of the tape as it is wound on the reels. Controls are specially simplified; five tape speeds are available, with 16 tracks on a 1in tape, and direct or FM inputs are acceptable.

Electro-pneumatic Pressurization Control

FOR the VC10 and other types, Normalair have developed an electro-pneumatic cabin pressure control system which combines the advantages of electrically relayed actuation signals with the proven reliability of pneumatically operated discharge valves.

The fundamental requirement of a pressurization system is TO control the cabin pressure automatically to required values under all conditions of flight without unacceptable pressure surges at any stage of control. A pressure controller, sensitive to absolute cabin pressure and differential pressure between cabin and atmosphere, is used to regulate the discharge action of one or more outflow valves; and subsidiary devices for varying the pressure datum, limiting surges and establishing control in case of equipment failure are incorporated. The system should "fail safe" and prevent loss of cabin pressure by more than an acceptable amount, despite any normally foreseen failure. In aircraft operating at 25,000ft or above, cabin altitude must be prevented from rising above an acceptable value if a discharge valve or valves fail towards the open position. An emergency pressure controller therefore takes over if cabin altitude tends to exceed a certain value and the crew must be able to override manually the automatic emergency control. A separate manual dump valve or an existing safety or discharge valve with a manual control is therefore provided.

Discharge or outflow valves can each embody a hand-operated ditching control and can be fitted in groups, depending upon the installation requirements and the flow handled. A further manual override allows the discharge valves to be closed in emergency or when testing the safety valves. Low-back-pressure filters and air driers are incorporated where cabin air meters into the controller or discharge valve. Should one or more of the outflow valves fail in the closed position, the remaining units can handle the full discharge flow with a negligible increase in cabin pressure and, when operating as safety valves, can pass the cabin outflow without the safety valve blow-off pressure being exceeded.

Should the pressure controller or discharge valve mechanism fail to ambient, the emergency controller(s) takes over and prevents cabin altitude from exceeding 10,000ft. Should a negative differential pressure arise, the reversal of pressure causes the outflow valve mechanism to open and prevent the negative differential pressure exceeding an acceptable amount.

Electro-pneumatic pressure-control systems are suitable for all classes of aircraft and have important advantages over purely pneumatic systems, especially when long pipe runs are to be avoided. Flow distribution through widely separated discharge valves is greatly simplified because valve openings can be accurately monitored and excellent control sensitivity obtained. Basic components are a pressure controller, a cabin altitude selecter, an electronic relay pack, one or more multi-purpose discharge valves and a dump valve. Electro-pneumatic relays on the discharge valves provide a control pressure between the cabin pressure inlet and the low pressure outlet.

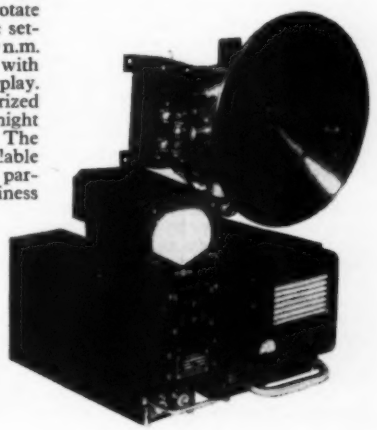
Although they respond to electrical signals, the discharge valves are themselves pneumatically operated, providing a good rate of response to airflow changes. Safety measures are readily incorporated. Pneumatic servo-operated safety valves similar in basic design to the discharge valves are also fitted; and in some cases both types are combined. The choice and the combination of safety and discharge valves is governed by the requirement for duplication of safety measures, for standardization of the basic valve and for the inward relief case. Both discharge and safety valves can act automatically as inward relief valves and either can cope with the maximum inward relief flow during an emergency descent. All discharge and safety valves can be fitted with ditching controls which allow their operating diaphragm chambers to be flooded with water to keep the valves closed. These controls are prevented from operating in flight and dumping cabin pressure by the emergency pressure controller on each valve.

Control in flight is by manual selection on the flight deck of cabin altitude and rate of pressure change, and by switches which can be used to close the discharge valves in the event of fire or system malfunction. Discharge air may be diverted during cruise through fixed nozzles, by-passing the discharge valves, to give some thrust augmentation to the aircraft. In this case, sufficient air still passes through the discharge valves to maintain normal control. The controller may be divided into sub-units if space is at premium and test connections are provided.

Collins Weather Radar

A NEW lightweight weather radar called WP-103 and weighing 50lb has been announced by Collins Radio Co. Extensive use is made of printed circuitry and transistors so that maintenance is simplified, and power consumption is reduced to 320W a.c. There are 73 transistors and eight valves in the pulse-modulated X-band system. The IF strip alone is about one-sixth as big and one-eighth as heavy as that of the earlier WP-101 and consumes less power than one valve heater in the earlier equipment.

The five main units are the receiver/transmitter, in a short $\frac{1}{2}$ ATR case; the synchronizer in a short $\frac{1}{8}$ ATR case; the control panel; indicator; and aerial assembly. Either 12in, 18in or 30in dishes are offered, the last-named able to rotate through 360°. Range settings of 150, 60 and 30 n.m. can be set together with iso-echo contour display. Bright tube and polarized dimming screen for night use are also offered. The WP-103 will be available early next year and is particularly suited to business aircraft.



Components of Collins WP-103 weather radar (see above)

Missiles and Spaceflight

CONTROL OF OUTER SPACE

THE problem of the international control of outer space is a new and increasingly vital element in the general problem of effective world organization to secure the freedom and welfare of the human race by sustained economic and social progress on the basis of universal law. In introducing his paper *The International Control of Outer Space* in these terms at the third colloquium on the law of outer space in Stockholm last month, Mr C. Wilfred Jenks commented "This is our assignment, not for this morning alone, but for a generation or more to come."

Author of *The Common Law of Mankind* and chairman of the commission on space law of the Institute of International Law, Mr Jenks gave in his Stockholm paper a lucid and wide review of the problems involved. His task, he said, was to pose questions rather than to answer them, and the most immediate issue was "How can we break the deadlock which at present bars the way to effective international control of space?"

During the recent disarmament negotiations, Mr Jenks said, both sides had accepted (subject to varying conditions which were not yet reconciled) the general principle that outer space should be used exclusively for peaceful purposes.

The General Assembly of the United Nations established in 1958 an *ad hoc* Committee on the Peaceful Uses of Outer Space. Although the committee was handicapped by the refusal of the Soviet Union and other States to take part it was able to adopt a most useful report. This, in addition to giving a convenient survey of the potential scope of space activities, the support facilities necessary for the effective conduct of space activities, and the existing arrangements for international co-operation, contained an abundance of practical suggestions concerning matters which should be further pursued.

"The report distinguishes between matters in respect of which international agreements providing for an 'open and orderly conduct of space activities' can 'form the basis of an international routine' without continuing co-operative action, and matters in respect of which 'there is need for active co-operative endeavours in which groups of nations assist each other in carrying out various phases of space activities.' It envisages international agreements dealing with such matters as the use of radio frequencies, the registration of orbital elements, the termination of radio transmission at the end of the satellite's useful life, the removal of spent satellites, the re-entry and recovery of space vehicles, the return of recovered equipment, identification of origin, and measures to minimize the adverse effects of possible biological, radiological and chemical contamination.

Types of Co-operation

"Among the measures of international co-operation in joint projects contemplated by the report are simultaneous sounding-rocket launchings, the international use of launching ranges, co-operation in the instrumentation of satellites and deep space probes, co-operation in tracking, telemetering and data processing, co-operation in the exchange and interpretation of data, and international arrangements to permit of a maximum use of communications and meteorological satellites.

"The committee grouped as legal problems susceptible of priority treatment the questions of freedom of outer space for exploration and use, liability for injury or damage caused by space vehicles, the allocation of radio frequencies, the avoidance of interference between space vehicles and aircraft, the identification and registration of space vehicles and co-ordination of launchings and arrangements governing the re-entry and landing of space vehicles; it classed as less urgent the question of determining where outer space begins, the provision of safeguards against contamination of outer space or from outer space, questions relating to the exploration of celestial bodies, and the avoidance of interference among space vehicles. While these proposals need wider support to make them practicable, they represent an invaluable point of departure.

"In 1959 the General Assembly established a new Committee on the Peaceful Uses of Outer Space, constituted on a broader basis, with a mandate to review the area of international co-operation in the exploration and exploitation of outer space for peaceful purposes, to study practical and feasible means for giving effect to programmes on the peaceful uses of outer space which could appropriately be undertaken under United Nations auspices, and to study the nature of the legal problems which may arise from the exploitation of outer space. It has not yet been possible, however, to hold a meeting of this Committee with the participation of all its members.

"The General Assembly has also approved in principle the convocation under the auspices of the United Nations, probably in 1961, of an international scientific conference for the exchange of experience in the peaceful uses of outer space, analogous in general character to the scientific conferences which have played so important a part in promoting the peaceful uses of atomic energy. The detailed arrangements for the conference are still, however, in suspense.

"The two specialized agencies of the United Nations most directly concerned with immediate developments, namely the International Telecommunication Union and the World Meteorological Organization, have already taken significant action. The International Telecommunication Union has allocated frequency bands for remote control of space vehicles and their equipment for the transmission of information from space vehicles; it has under study future needs for these purposes, the identification of radio-emissions from space vehicles, codes for the transmission of information from space vehicles, methods of providing for the cessation of radio emissions from space vehicles, and the use of space vehicle relays to extend terrestrial telecommunication facilities; and it has made arrangements for an Extraordinary Administrative Radio Conference to be held, if timely, in 1963 to consider certain of these matters further.

"The World Meteorological Organization is playing an active part in advising on the use of artificial satellites for meteorological purposes and has envisaged that its future responsibilities might include participation in the planning of space vehicle tracking stations for meteorological purposes and in the design of the necessary computational practices and technique for the reduction of the data to amenable forms for practical use.

A Preliminary Examination

"The Administrative Committee on Co-ordination, which consists of the Secretary-General of the United Nations and the executive heads of all the specialized agencies, has, at the request of the Economic and Social Council, made a preliminary examination of the steps desirable to promote co-ordination among the organizations of the United Nations family as regards the peaceful uses of outer space, and has the whole matter under continuing review."

This widespread preoccupation with the matter was encouraging, Mr Jenks continued, but it was disconcerting that few positive steps had yet been taken towards establishing effective arrangements for international control. This was partly because one basic condition of the establishment of an effective international regime was not yet fulfilled, and partly because of four major initial dilemmas. What were these roadblocks to progress?

The basic condition for an international regime which was still lacking was a sufficiently widespread distribution of space capabilities. According to the speaker, there were clear indications that space capabilities were likely to be more widely distributed in the near future.

Once this condition had been fulfilled we should still be confronted by four major dilemmas:—

(1) How to reduce the danger that space would become militarized before an agreed international control of armaments was concluded.
(2) How to achieve a partnership of policy, law, science and technology in bringing space activities within the rule of law.
(3) How to avoid the danger that the pace of scientific and technological development would so outrun that of effective international control that events rather than policy would crystallize the pattern of the future.
(4) How to reconcile vigorous initiative in specific international activities in space with the importance of ultimate co-ordination in an overall control framework.

An Insoluble Problem?

Mr Jenks went on to amplify these four points. "Our first dilemma," he said, "is to reconcile the needs of peace with the dangers of war, the claims of scientific co-operation against the claims of military security. It represents an insoluble problem unless we can create a larger measure of international confidence —a measure of confidence to which the elimination of barriers to the full interchange of scientific information relating to and arising from activities in space, the pooling of certain activities in space, and guarantees of mutual security such as provision for the advance notification of launching and an inspection system can all make an important contribution.

"This dilemma is but one of many illustrations of the interdependence of all our problems. We cannot solve any of them unless we attempt to grapple simultaneously with all of them, but it is equally true that we cannot hope to solve any of them if we are unwilling to advance in any field until satisfied that the necessary correlative action has already been taken in other

Control of Outer Space . . .

fields. We must therefore find lines of advance which represent a possible breakthrough from stalemate.

"Our second dilemma is to determine the respective roles of science, political action and law in international co-operation in space. International scientific co-operation of the type exemplified by the International Geophysical Year and the work of the International Council of Scientific Unions has initiated international co-operation in space with an encouraging measure of success. . . . But no scientist should cherish the illusion that space affords a new opportunity for the withering away of the State.

"The existing space programmes are government ventures; the launching facilities which have made them possible have been created and are operated by the military; we cannot hope to avoid confusion and frustration or to keep power politics out of space unless scientific co-operation and political understandings are translated into firm legal obligations. The only solution for the dilemma is a close partnership of policy, law, science and technology in determining the proper scope and content of such obligations.

"Our third dilemma is to weigh the possible dangers of over-hasty action against the certain danger of excessive caution; we can resolve it only by distinguishing between matters in respect of which early action is imperative and matters which can and should be left for more mature consideration in the light of fuller knowledge and experience.

"Similarly, the dilemma presented by the need to secure vigorous thrust in particular ventures in co-operation of space without prejudice to the long-term need for overall co-ordination can be resolved only by an empirical approach in which both elements in the problem are kept in mind in the planning of such ventures."

Specific Problems

Turning from generalities to specifics, the speaker considered next the problems presented by "the fact of instruments in space and by the prospect of man in space."

The use of instruments in space would pass from the experimental to an operational phase with the placing in sufficiently stable orbits of a number of communications, meteorological, navigation and astronomical observation satellites able to provide dependable telecommunication relays, meteorological services, navigational aids and space observatories. These constructive possibilities might be overshadowed at any time, however, by the use of space for military purposes. What role had the law to play and what measures of international control were required?

"Unless space is exclusively dedicated to peaceful and scientific purposes, and a satisfactory inspection system designed to make the exclusive dedication of space to peaceful and scientific purposes effective is introduced, all else will be precarious. This is primarily a problem of the control of armaments rather than a problem of the control of space. Pending a satisfactory outcome of negotiations for disarmament, what other steps can usefully be taken?"

In the first place, Mr Jenks submitted, legal regulation was a necessary element in the measure of common discipline without which the scientific exploration of space could not proceed fruitfully. This was obviously so in the case of telecommunication, a field in which the International Telecommunication Union had already taken the initiative, and was equally applicable for measures to minimize the adverse effects of possible biological, radiological and chemical contamination of and from space. Here the COSPAR committee on contamination in extra-terrestrial exploration had taken the initiative, but legal regulation might well be needed to buttress understandings among scientists. Unless clear rules on these matters existed from the outset and were strictly applied, space research would not yield the fruits which we were entitled to expect from it.

"These prospective measures represent a minimum of international co-operation without which nobody will be able to begin to reap efficiently the fruits of the scientific exploration of space; a much larger measure of co-operation will be necessary before anybody can reap the full harvest, the garnering of which involves simultaneous observation in many parts of the world; a still larger measure of co-operation will be necessary to make that harvest available to everybody in such a manner as to eliminate national rivalry from space."

This last stage had a major bearing on the demilitarization of space. Mutual protection against surprise attack was the key to making effective the exclusive dedication of space to peaceful purposes; the chief danger might well lie in some inoffensive space vehicle being mistaken on a radar screen, at a moment of heightened international tension, for an intercontinental ballistic missile.

Advance notification of launching schedules, the filing of flight plans and the use of agreed radio codes could all play a significant part in eliminating the military element. A special organization, analogous to that projected for the detection of violations of the proposed nuclear test ban, might be desirable.

Space activities for communications, meteorology, navigation and astronomy would need, as a minimum, codes of regulations; they might also present an opportunity to organize such operations as world public services rather than as national or commercial undertakings. The International Telecommunication Union, World Meteorological Organization and Intergovernmental Maritime Consultative Organization were not operational bodies at present, but the future possibility of their adopting certain operational responsibilities should not lightly be set aside.

If this could not be accomplished within the normal structure of existing specialized UN agencies, special bodies similar to the European Council for Nuclear Research should be envisaged. Alternatively a more comprehensive body analogous in general conception to the International Atomic Energy Agency but with more specifically operational responsibilities might be created within the UN framework.

Government and Industry Roles

Large commercial interests had been involved for some time in the design and manufacture of space equipment, and had a heavy investment therein. In the United States, the determination of the future relationship between government and industry in the utilization of space had become a major preoccupation of policy for the immediate future. Large, highly controversial and urgent questions affecting powerful economic interests and having far-reaching political implications were involved.

"The opportunity to organize operational activities in space as world public services will be a fleeting one but every effort should be made to grasp it and to exploit it to the full. Success in this respect would be a major contribution to the establishment of an effective international control of space."

Turning to the forthcoming advance from instruments in space to man in space, Mr Jenks envisaged three main phases. The first phase would presumably be one of hazardous and intermittent exploration with at most a handful of people in space at any one time. For this phase the speaker had suggested a "Monroe Doctrine for the Moon" concept.

"In this first phase we cannot reasonably hope to have evolved either adequate institutional arrangements or sufficiently fully accepted legal principles to meet longer-term needs, nor will it be practically necessary that we should have done so, but it will be vital to have established the position that such arrangements and principles will be evolved by common agreement on the basis of growing experience as they become necessary and that meanwhile no unilateral claim to extraterrestrial sovereignty or jurisdiction or to exclusive access to or use of any extraterrestrial place or resource will be recognized. An immediate declaration of policy to that effect, preferably by the General Assembly of the United Nations, is eminently desirable. The Monroe Doctrine for the Moon concept represents a holding operation designed to ensure that longer-range plans are not prejudiced by unilateral action before they have had time to mature."

Antarctic Treaty Analogy

In formulating such longer-range plans, for the second of the speaker's three phases, Mr Jenks suggested that we should be guided by the analogy of Antarctica. The Antarctic Treaty, signed last December on behalf of all the 12 countries which participated in the IGY Antarctic programme, stated that Antarctica should be used for peaceful purposes only and that all military activities there should be prohibited. Full information concerning scientific plans and results was to be exchanged; territorial claims were frozen for the duration of the treaty; and nuclear explosions and disposal of radio-active waste in the area were prohibited.

If such a treaty was possible for Antarctica, Mr Jenks asked, why was it not possible for space? This would represent a bold and constructive advance.

As activities in space developed, an Antarctica-type treaty might prove to be inadequate and more comprehensive arrangements for international control of outer space might be necessary. We must therefore envisage a third phase, that of United Nations control.

"When man ventures into space he takes with him much of his earthly heritage, including the established rules of international law in so far as they are applicable. The Charter of the United Nations is not earthbound. The General Treaty for the Renunciation of War and the Statute of the International Court of Justice, 'international custom as evidence of a general practice accepted as law' and 'the general principles of law recognized by civilized nations' are all applicable to human relations in space." This was the framework, the speaker suggested, within which the special political and legal arrangements needed for effective international control at this stage could and must be solved.

Mr Jenks concluded by putting forward six main questions,

Control of Outer Space . . .

generally agreed later by most other participants at the Colloquium to comprise one of the most constructive sequences of practical suggestions yet put forward in this field:—

(1) Why cannot we negotiate forthwith a network of international agreements dealing with such matters as space telecommunications, the avoidance of contamination of and from space, mutual aid in simultaneous observation, mutual protection against surprise, the freeing of space information from security restrictions, injury or damage caused by space vehicles, and the use in space of observational equipment, to be followed by further agreements as required?

(2) Why cannot we, while there is yet time, organize space telecommunication relays, space meteorological services, navigation satellite systems and space observatories as world public services maintained under United Nations auspices in the interest of all mankind?

(3) Why cannot we, before scientific adventure places in jeopardy the existence of human life itself, provide machinery for the notification of, and exchange of information concerning, experiments, tests and development schemes, in space or elsewhere, which are liable to affect the natural environment of other States and possibly of the whole human race?

(4) Why cannot we immediately, before man is in space, promulgate the principle, perhaps in a Declaration by the General Assembly of the United Nations, that no unilateral claim to extraterrestrial sovereignty or jurisdiction or to exclusive access to or use of any extraterrestrial place or resource will be recognized?

(5) Why cannot we negotiate at an early date a Space Treaty, analogous in general character to the Antarctic Treaty, providing that space shall "continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord" and embodying the arrangements necessary to this end?

(6) Why cannot we lay the foundations now for a comprehensive plan of United Nations control of all Earth-based and Earth-directed activities in space?

Upon the answer given to these questions, Mr Jenks commented, might depend not only the future of man in space, but equally the future of man on Earth.

Sport and Business

BETWEEN 50 AND 60 AIRCRAFT are expected to attend the Popular Flying Association's rally at the College of Aeronautics Aerodrome, Cranfield, this weekend (September 9-11). Among visitors from France, it is hoped, will be the Jurca Tempête and other types new to this country. Arrival times for visiting aircraft are from noon to 7 p.m. today (Friday), and 9 a.m. to 1 p.m. tomorrow. An informal display will be given on Saturday afternoon, and the prizegiving will take place at a banquet the same evening.

IMPERTURBABLE FORMATIONS apparently oblivious to aircraft weaving and diving past them, two-seaters and single-seaters twisting and jinking all over the sky, and fast twins dashing in under full power gave the impression to spectators at Elstree on Sunday, August 14, of a short but full-scale aerial war. The occasion was the annual tea patrol of the London School of Flying and rarely has a 3s 6d tea been so hotly defended. Into the air around Elstree aerodrome the school put up 17 patrolling club and privately-owned aircraft, and between them they spotted all but five of the 26 presumably hungry pilots who visited them from other clubs.

The clever ones who reached the airfield without their registration letters being spotted were Nicholls in Magister G-AKAS from Biggin Hill, O'Cleary in Tiger G-ALWW from Baginton, Last in Tri-Pacer G-APYW, Bennett in an Auster from Stapleford, and Spiller in his famous Proctor G-AHFK—but practically every defender spotted the Tiger Club formation from Redhill. All in all there were some 30 arrivals in a period of 36min and, including the defenders, 64 aircraft made use of Elstree's runway in little more than an hour. A consolation prize was awarded to F. Ringer in Auster G-AJYC who, although spotted by the defenders, arrived on the sealed time.

THE PROPOSED MERGER between Manchester Flying Club and Cheshire Flying Club, erroneously reported in our issue of July 22 as having already taken place, has been shelved. Manchester Flying Club continues its operations at Barton, with Harry Knight as chief flying instructor.

CUSTOMS FACILITIES are now available at Shoreham Airport during the following times: weekdays and Sundays, 9-10 a.m., 2.30-3.30 p.m. and 6-8 p.m.; Saturdays, 9 a.m.-8 p.m. Customs attendance at other times should be arranged in advance with Air Traffic Control at Shoreham (Shoreham-by-Sea 2303).

RETROSPECT

From "Flight" of September 10, 1910

Instruments for Flyers: By degrees helpful instruments will be evolved for aviators as their usefulness and necessity becomes apparent. What appears to be one of the most practical is a spirit-level, the use of which has been advocated in *Flight* for some time. M. Bregi, at Mourmelon last week, found an instrument of this nature of practical value to him when making high flights. Having ascended to about 4,500ft, and being entirely enveloped in clouds so thick that he was unable even to see his elevating planes, he found it very difficult to know whether he was following a horizontal line or not. Having a level on his machine, however, he was able to watch against the danger of too vertical a descent, until he managed to get clear of his cloudy surroundings, and he now declares that this instrument will always form part of his equipment whenever flying.

ASSOCIATED AIRLINES, the business-flying subsidiary of Broken Hill Pty and Consolidated Zinc in Australia, has ordered a Grumman Gulfstream. Delivery by the company's own crew to the base at Melbourne Airport will be made in December. The aircraft will be used for executive flying. A Piaggio P.166 has been ordered by Zinc Corporation and will be based at the Associated Airlines hangar and serviced there.

DELIVERY FLIGHTS of Grumman Ag-Cat agricultural aircraft to Uruguay and Puerto Rico have recently been completed. The 8,995-mile flight to Paysandu, Uruguay, involved 156 hours' flying and a crossing of the Andes, while the 2,469-mile delivery to Ponce, Puerto Rico, included some 1,200 miles over open water. Powered by a 220 h.p. Continental, the Ag-Cat is produced for Grumman by Schweizer Aircraft of Elmira, New York.

DELIVERY HAS BEEN TAKEN of a Grumman Gulfstream by a South African mining house, the Anglo-American Corporation. It will be used for ferrying executives between the company's mining interests on the Witwatersrand, Kimberley, South West Africa and Tanganyika. The Gulfstream supplements the Anglo-American fleet of an executive Heron and Dove and an aerial-survey Dakota based at Rand Airport, Germiston, a Beaver based in Namaqualand and another Beaver at Mwadui. A subsidiary of the corporation, Consolidated Diamond Mines of South West Africa, has a Twin Beech and a Dove.

Left, one of the oldest Swiss aircraft on the register is this Dewoitine D-26. After the war some of these ex-fighters were purchased by aero clubs and six are still being used as glider tugs. Right, members of the recently formed Merlin Flying Club, employees of Rolls-Royce Ltd at Derby and Hucknall, who have been flying as temporary members of the Sherwood Flying Club at Tollerton

SERVICE AVIATION

Air Force, Naval and Army Flying News

RAF Fighter Command aircraft from the Spitfire to the Lightning are represented in this unique Air Ministry photograph. The formation, led by a Lightning F.1, numbers from left to right a Javelin FAW.9, Hunter F.6, Meteor F.8, Spitfire PR.19 and Hurricane 2C

MEAF Appointment

HAVING been Assistant Chief of the Air Staff (Training) since October 1958, and before that Air Officer in charge of Administration at Flying Training Command, AVM John Worrall is to be Senior Air Staff Officer at MEAF headquarters from September 19. During the war he commanded No 32 Sqn (Hurricanes) at Biggin Hill in the early stages of the Battle of Britain, being awarded the DFC.

Queen's Chaplains

TWO RAF chaplains have been appointed Honorary Chaplains to the Queen. They are the Rev B. E. Knight, assistant chaplain-in-chief at RAF Germany headquarters, and the Rev C. Y. McGlashan, principal chaplain (Church of Scotland and Presbyterian) at Coastal Command headquarters. They succeed the Revs J. N. Keeling and J. T. Hankin, their appointments dating from April 8 and August 18 respectively. Mr Knight, who is a qualified pilot, sometimes flies himself round his "parish."

893 Sqn Re-formed

AT RNAS Yeovilton on Thursday last week the Royal Navy's new D.H. Sea Vixen squadron, No 893, was commissioned for service. Its formation (referred to on this page last week) marks the revival of a number first given to a Martlet squadron in 1942. This unit supported Operation Torch and the Sicily and Salerno landings, before being disbanded in November 1943. The second 893 Sqn was formed in 1946, with Sea Venom 21s, participating in Operation Musketeer at Suez when embarked in HMS *Eagle*. Later it carried out operational trials of Firestreak missiles, then re-equipped with Sea Venom 22s, taking part in last year's successful North American tour of HMS *Victorious* before being disbanded in February 1960. The new 893 Sqn, commanded by Lt Cdr F. D. Stanley and equipped with Sea Vixen FAW.1s, is to embark early next year in HMS *Centaur*.

Technical Training SASO

AN appointment at Technical Training Command recently announced is that of Air Cdre A. T. Monks, who became Senior Air Staff Officer on August 24. He was formerly Controller of Telecommunications at the headquarters of Signals Command.

Fighters on terra firma: the aircraft pictured above, and their pilots, on the tarmac at RAF Coltishall. They are to appear in flying displays on Battle of Britain "At Home" Day (September 17), when 25 RAF stations will be open to the public

IN BRIEF

Sir Douglas Glover, MP for Ormskirk, has consented to become president of No 2348 (Maghull) Sqn of the Air Training Corps.

The variety concert at London's Victoria Palace earlier this year, organized as the "show business tribute" to the RAF Benevolent Fund, on its 40th anniversary, realized £4,602.

Among German aircraft of the last war being placed on permanent display at RAF Biggin Hill is a Messerschmitt Me 110 which has been restored by No 60 MU at RAF Church Fenton.

Imperial Defence College officers recently visited the Hiller Aircraft Corporation premises at Palo Alto, Cal. They participated in flying demonstrations by H-23D (military) and 12E and E4 (civil) helicopters.

Wg Cdr J. Greenhill has been appointed jet instructor to the Royal Jordanian Air Force in succession to Wg Cdr "Jock" Dalgleish, who has completed his assignment period and returned home at his own request.

One of the exhibits at the Battle of Britain "At Home" at RAF Shawbury on September 17 will be the map and flight plan used by the Nazi leader Rudolf Hess when he flew from Germany to Scotland in an Me110 in 1941.

The Air Council is giving a reception at Lancaster House, St James's, next Wednesday (September 14), as part of the celebrations commemorating the 20th anniversary of the Battle of Britain. Representatives of "The Few" will be among the guests.

Eighteen members of Birmingham University Air Squadron took part in an ASR exercise off the Suffolk coast on Tuesday last week, during their summer camp at RAF Martlesham Heath, being picked up by a Whirlwind of the No 228 Sqn detachment at Felixstowe.

No 55 Sqn, RAF, is holding its seventh annual reunion on Saturday, October 22, at the Pathfinder Club, Mount Street (off Berkeley Square), London W1, at 6.30 p.m. Tickets 7s 6d. Further details from I. Calverley Esq, 38 Pondfield Crescent, St Albans, Herts.

The recently formed Specialist Navigation Association is holding its inaugural dinner (preceded by an inaugural meeting at 6.30 p.m.) at the RAF Club on Saturday, November 19, at 7.30 for 8 p.m. Attendance is open to all specialist navigation graduates since the course started in 1919, and tickets (£2) are available from Wg Cdr H. L. Lewis, RAF Flying College, Manby, Louth, Lincs.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

The Hurricane and the Spitfire

IN reply to Wg Cdr Beamont (Correspondence, August 26), may I say that, before writing *Strike from the Sky*, I talked to some three dozen British, Polish, and German fighter pilots, and that one of my "set" questions was precisely this comparison between Spitfire, Hurricane, and 109? A few, who had flown Hurricanes only, tended to praise that aircraft, but an obvious and understandable element of loyalty was present—they did not want to run down an old friend. The pilots who had flown Spitfires as well as Hurricanes, or Spitfires only, or 109s only, gave, with varying degrees of emphasis, a generally agreed picture: that the Spitfire and 109 were so close in performance that it was hardly worth arguing about, and that both were (I quote a Hurricane pilot) "infinitely superior" to the Hurricane.

They did not place great value on the latter's manœuvrability; after all, if that was the main criterion, then the Fiat 42 was the best fighter of the Battle of Britain. In their view, speed and climb (particularly at height) were the decisive factors in fighter v. fighter combat: ability in the first place to deliver an attack under favourable conditions.

To the German bomber crews these arguments were academic; if the Hurricanes got at them they were at least as deadly as Spitfires. Nevertheless, the Hurricane was obsolescent and did not, as a front-line fighter, long survive the Battle of Britain, whereas the Spitfire, in various marks, was operational in its original role to the end of the war. That, I think, is conclusive. The two other Services do not find it necessary to maintain that their every item of equipment was at all times superior to the enemy's; and we do, somehow, still manage to win our wars.

I feel that only casual reading could produce the statement that little new light has been thrown recently on the battle; but, for my part, I would say that, disregarding the notorious soft-pedalling of the fate of the unfortunate Channel convoys, what is new concerns not so much what happened, but the perhaps more important "reason why." If I forebore to point out each occasion where a fresh and balanced interpretation was now possible, it was because not only would this have smacked of Historian's Disease (*backbitus furioso*), but that anyway the list of corrections was so long that it would have required an additional chapter to itself.

Rowlands Castle, Hants — ALEXANDER McKEE

Jet Fuel and Safety

IT is a disappointment that no one has chosen to take issue with me over my article "Jet Fuel and Safety," published in *Flight* for June 10. The reason for the silence is not, I think, hard to seek: the airlines and oil companies concerned dare not risk public controversy in this matter. Indeed, an oil company official, in discussing the article with me, admitted that the subject was "much too hot" for his company to make any reply.

Meanwhile, Lord Brabazon, chairman of the Air Registration Board, has again denounced those airlines currently using JP.4 fuel, and has threatened to name them so that passengers can decide for themselves whether to accept the reduced standard of safety being offered by these operators. Things have come to a sorry state when passengers have to be the arbiters on standards of airworthiness; but in these days, when prestige is being given precedence over everything else, it was never more important that public opinion be properly informed as to what is going on.

Harpenden, Herts — J. W. RICKARD

Curtailed Corporation

IN his admirable review [page 303, August 26] of an admirable work (A. J. Jackson's *British Civil Aircraft 1919-59, Vol. 2*) Mr Brooks finds it inexplicable that BEAC is referred to by its properly abbreviated title. Knowing Mr Jackson's deep regard for accuracy, it would be rather more inexplicable if the Corporation was *not* thus described.

What is more genuinely inexplicable is BEAC's renowned distaste for its own title, for it is a standing joke that its use is practically guaranteed to provoke near-hysterics at "establishment" level in the Corporation! There is no similar evidence that the many thousands of other corporate bodies are so easily distressed by the very sound of their own names.

Nobody would deny the Corporation's right to use the abbreviated BEA as an eye-catching trademark—indeed, it is quite accepted commercial practice to do so—but when one formally describes or addresses an animated body it is surely both correct and polite to do so properly? That is exactly what Mr Jackson has done.

I don't wish to labour the issue, but it would be interesting to learn why BEAC is at such pains to labour it—even to the extent of enrolling the Press as accomplices in the glorious struggle for inadequacy! This would seem to be a suitable moment for the long-awaited explanation, and nobody is better qualified to provide it than Mr Brooks himself. Why, Mr Brooks, is your Corporation so touchy about its corporation? Why does your unhappy condition not extend itself to BOAC, EAAC, New Zealand NAC, and who-have-you?

Where the "anti-nationalization elements" are supposed to fit into the argument is something I do not pretend to understand. Mine is no more than the query of a simple, non-progressive, non-BEAtnik, fare-paying fuddy-duddy.

Pinner, Mddx — D. K. FOX

The Shape of Echo

HAVE you slipped a decimal point or two? You quote [page 242, August 19] a total thickness for the skin of the Echo satellite of 0.0196in. Unless I err, this would make the skin of the collapsed satelloon nearly 60 cu ft in volume; clearly impossible. It is inconceivable that the skin should be elastic; what, in fact, is the true figure?

And what, in passing, limits the expected life to a year? The skin being inelastic, it seems likely to maintain the distension given it after launching. Will light pressure force it out of orbit? Or is there sufficient air at 1,000-plus miles to brake it down?

Ingatestone, Essex — J. E. ENEVER

[We are grateful to our correspondent for discovering this error. The original US report correctly gave the thickness of the Mylar polyester film of which the 100ft-diameter satellite was made as 0.0005in; but a later transmission corrected this to 0.5mm (0.0196in) and this was the figure accepted by *Flight* and most other publications. The weight of Mylar was 136lb, and its volume was 2,339.2 cu in; the folded envelope was packed into a spherical container with a diameter of 26in. The most recent NASA release confirms that the sphere was inflated by a subliming powder, although the original plan was to utilize the evaporation of water. Until August 24 (i.e., during its first 12 days) Echo 1 had been continuously in sunlight at a temperature of about 240°F. Now it is in darkness for short periods, and at about −80°F the gas in its interior returns to the solid state, so that the sphere is partially collapsing; its irregular shape is evident from the sudden variations in its brightness during the past few weeks. It has already been riddled with micrometeorites, and its ultimate fate seems uncertain.—Ed.]

"SATCO Ready for Duty"

COMMENTING in your issue of July 22 on the impending use of the first version of the SATCO system at Schiphol, you mentioned that "during a recent visit to the Dutch company a high-ranking FAA official stated that the system is two to four years ahead of contemporary American development."

Believing this assertion to be factually incorrect, may I inquire when and by whom such a statement is alleged to have been made?

London W5 — E. W. PIKE, Manager, Air Traffic Management Division, General Precision Systems Ltd

[The correspondent who sent the report informs us that the US official was Mr James L. Anast, chief of the Bureau of Research and Development, FAA. The statement by Mr Anast, he says, has been quoted by Mr J. W. F. Backer, Director of Civil Aviation in the Netherlands. Our correspondent reports that he has checked on this information with the press office of the DCA, who have confirmed it. He states, moreover, that one of the officials of Hollandse Signaal gave him an identical statement during a conducted tour of the installation and in the course of a private talk.—Ed.]

SOS from Fiji

FROM far-away Fiji comes an SOS for maintenance and service instructions for a Salmson radial Type AD9R (Serial 212). We cannot help from the library here, but one of your readers may be able to—in which case the writer is Mr Dallas Lee, c/o P.O. Box 207, Suva, Fiji.

London W1 — F. H. SMITH, Librarian, the Royal Aeronautical Society

FORTHCOMING EVENTS

Sept. 5-11. SBAC Display and Exhibition, Farnborough.
Sept. 8-12. AGARD and Instituto Lombardo di Scienze e Lettere: Seminar on Propulsion for Astronautics, Varenna.
Sept. 9-12. Popular Flying Association Rally, Cranfield.
Sept. 10-11. Glamorgan Flying Club: At Home, Rhoose Airport.
Sept. 11. International Landing Contest, St Nicholas Maes.
Sept. 12-16. International Council of the Aeronautical Sciences: Second Congress, Zurich.
Sept. 12-18. Battle of Britain Week: Exhibition, Horse Guards Parade, London; RAF Airfield "At Homes," September 17.
Sept. 14. Kronfeld Club: Film of German World Championships, by John Furlong.
Sept. 21. Kronfeld Club: "Flying in the US Nationals," by Philip Wills.
Sept. 25. Milan Aero Club: Helicopter Rally.
Sept. 28. Kronfeld Club: Meteorological Discussion.
Sept. 26-Oct. 1. AGARD Structures and Materials Panel Meeting, Athens.
Oct. 3-7. AGARD meetings (including 10th General Assembly), Istanbul.

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